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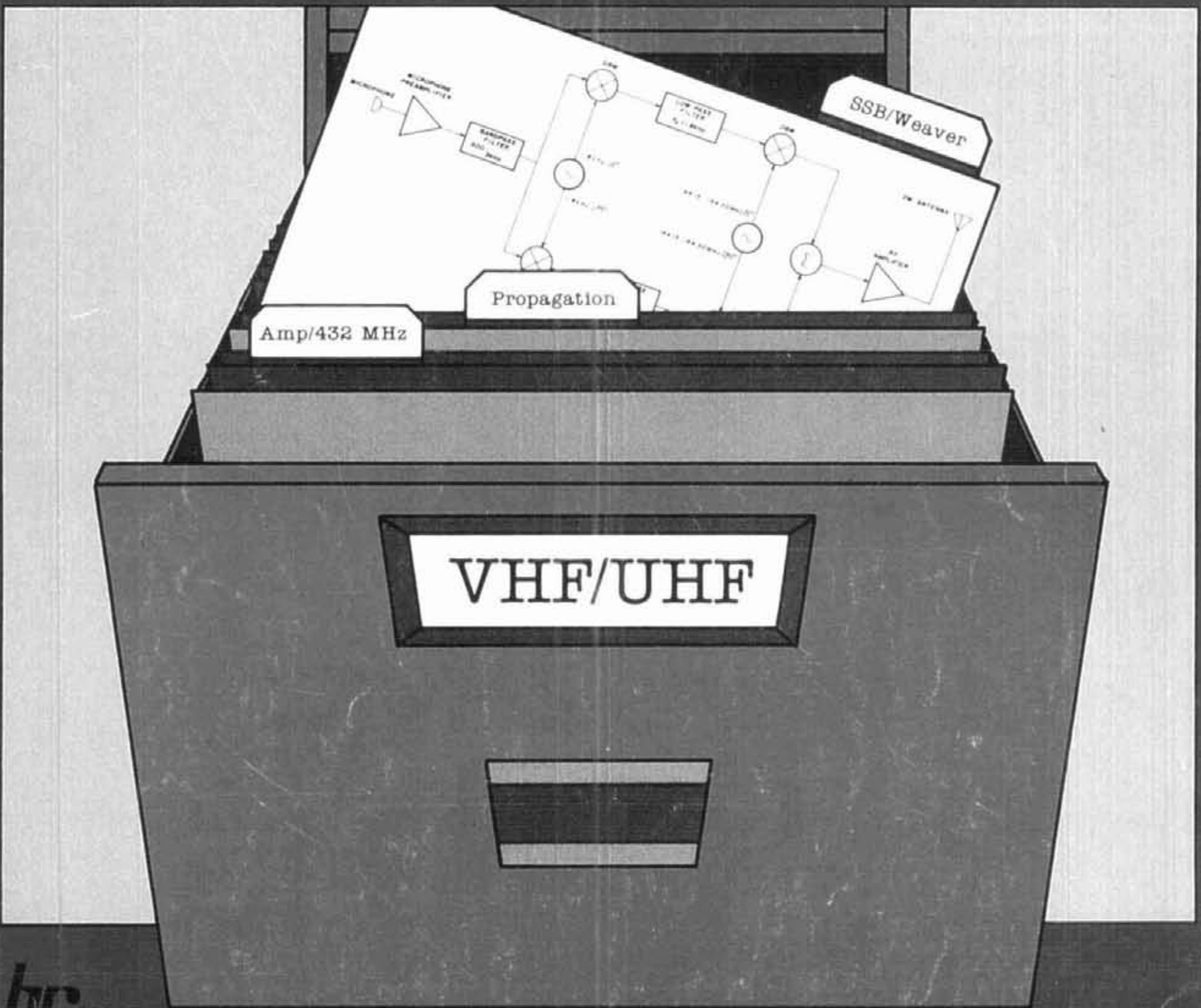
annual VHF/UHF issue

ham radio magazine



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JULY 1985

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contents

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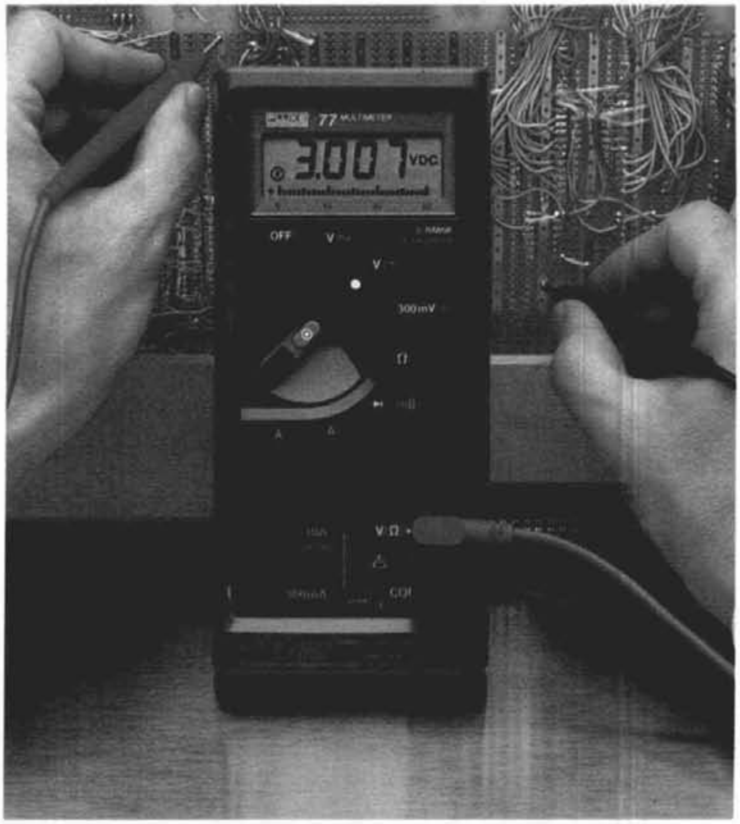

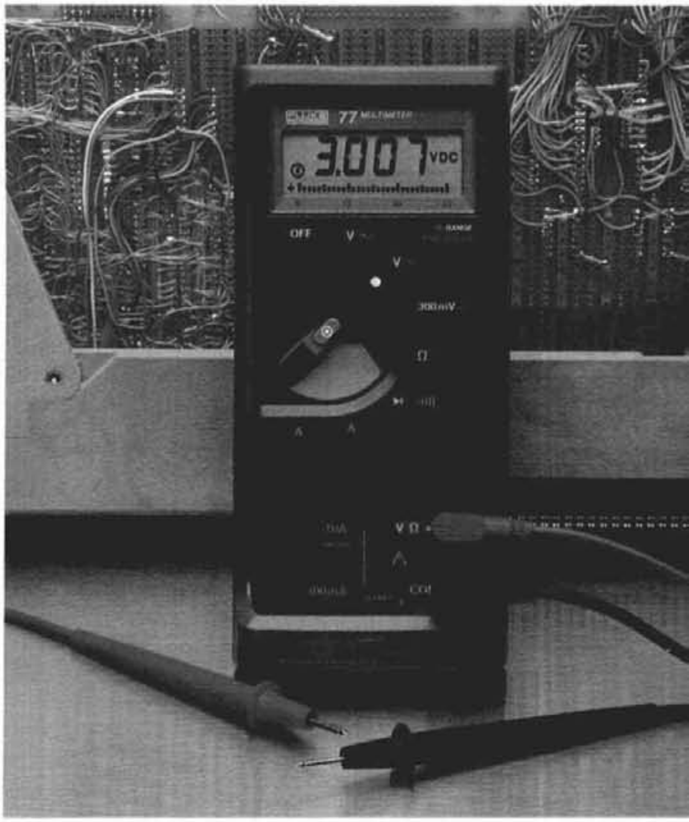

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REFLECTIONS

need we be concerned?

I have a nasty habit. *I'm an inveterate reader. You could almost say I'm compulsive about it.* I read *everything* that comes across my desk and have a library — both at *ham radio* and at home — that for volume, rivals anything else I own. To me, it's just as enjoyable to read little tidbits here and there as it is for other people to have those little in-between-meal snacks. But a strange thing happens to you in the process of reading everything you can lay your hands on. You start to see correlations between supposedly independent facts or events.

Before you read the next paragraph, please understand that I've only begun to delve into this issue, and that what I'm about to say has potential for causing alarm. At *ham radio,* we believe that writers and editors are ethically obliged to thoroughly research every story before a drop of ink is spread. But now — given the seriousness of the news, and the credibility of the sources — I'm going to bypass that fundamental principle of responsible journalism and call your attention to a potentially widespread and significant hazard.

A small article that originally appeared in a recent issue of *Broadcasting* was picked up and retransmitted by the W5YI Report of May 15. What caught my eye was an item about a series of complaints filed by residents living near Seattle's Cougar Mountain. Their concern was with "excessive exposure to RF non-ionizing radiation resulting from 21 towers housing FM broadcast, microwave, and two-way communications antennas."

"So what," you say, "We've all heard, one time or another, about the danger of exposure to fields in excess of 10 milliwatts/cm^2." The important point in W5YI's story was that "a growing number of scientific studies suggest the possibility of cell damage even *without* a recognizable rise in body temperature." Until now, I was under the impression that for damage to occur, a rise in temperature also had to occur.

Continuing on the same subject, W5YI noted another story that appeared in the April 27th issue of *Science News,* in which a Washington State epidemiologist reported "a provocative study linking death from leukemia with employment in professions that suggested possible exposures to high electric and magnetic fields." According to W5YI, the study of 546 New Zealanders identified as leukemia patients found "a significant excess of leukemias among electrical workers and radio/television repairers."

A third story cited, among hams diagnosed as having a particular form of leukemia (myeloid), a higher incidence of mortality than found among members of the general public with the same disease.

There are those who'll say that statistics can be presented to prove any contention, and maybe that's so. But I do seem to recall that the Soviets have a much lower acceptable limit for non-ionizing radiation: approximately 100 *micro*watts/cm^2.

Perhaps this would be a good time to re-examine the amount of radiated power from that unbalanced transmission line, single-wire feed antenna, or close-by antenna. Using a backwards argument, maybe there's even some good sense in placing your antenna higher, on a taller tower. Doing this certainly won't hurt its performance.

Let me assure you that this isn't just a thinly veiled attempt on my part to influence you all to go QRP so my puny signal will be more competitive . . . it's an attempt to call your attention to a serious matter that will be discussed more fully as more information becomes available.

Rich Rosen, K2RR
Editor-in-Chief

presstop de W9JUV

GREATLY EXPANDED NOVICE PRIVILEGES WERE PROPOSED by ARRL's Executive Committee at its May meeting in Rochester. Basically, the committee recommended giving Novices both phone and digital privileges on three bands, two of them UHF. Perhaps the most significant element of the proposal is the addition of both phone and digital communications privileges on 10 meters. There the Novice band would become 28.1-28.5 MHz, with the bottom 200 kHz for RTTY, AMTOR, and packet as well as CW and the 28.3-28.5 MHz slot SSB and CW only (to preclude use of converted AM CB radios). Under the present rules Technicians would also gain 10 meter privileges along with Novices; power for both would remain 200 watts out but that limit wouldn't apply to others. One important problem the expansion would cause is with the 10-meter beacon band, now 28.2-28.3 MHz; some possible alternatives for beacon operators were also discussed.

On UHF The Committee Recommended Giving Novices Full Privileges on the entire 220 MHz band and 1246-1260 MHz. They'd be permitted to use but not put up repeaters. Power output for Novices would be limited to 25 watts on the 220-MHz band, and 5 watts on 23 cm. The new privileges would require some expansion of the Novice exam questions; already licensed Novices would, of course, be grandfathered into the new modes and bands.

At Presstime This Is Still Only An Executive Committee Proposal for the League Board of Directors to review, then adopt or reject. However, the concept of expanding Novice privileges as a means of making the entry level license more attractive has seen increasing support inside as well as outside the League for some time. In addition, FCC Special Services Chief Ray Kowalski indicated at Dayton that the Commission was also looking with favor toward a more attractive Novice license package.

If The Directors Do Vote In Favor Of Increasing Novice Privileges, look for the ARRL to file a Petition for Rule Making to the Commission very soon. Since the future of the 220 MHz band is still under a cloud, the League's proposal will probably be worded in such a way that the FCC can leave that band out of any resulting NPRM if it so chooses.

ALL VECS ARE INVITED TO GETTYSBURG AUGUST 8, when the FCC will host a familiarization meeting for them. Purpose of the all-day session is to permit the VEC representatives and the FCC people they work with to meet each other face to face, so both can better appreciate the problems each has with the program and the licensing system. Particular attention is planned for paperwork errors; though some VECs are very good, a survey of April applications showed almost two-thirds of one VEC's submissions had significant errors! Timeliness is still another problem that's to be addressed at the meeting, with some VECs chronically late in submitting their exam session results.

THE SPACE SHUTTLE'S PRIME AMATEUR BAND DOWNLINK FREQUENCY will be 145.55 MHz, and at presstime launch was still scheduled for July 15. Amateur operation could occur as early as Mission Day Two, though expectations are that little, if any, of WØORE's or W4NYZ's time on the air will be devoted to unscheduled two-way QSOs. They will be doing a good deal of work by prearrangement with various schools and clubs, however, and hope to provide live or pre-recorded SSTV downlink signals during periods when they can't be on themselves.

RTTY, FAX, AND SSTV WERE ALL AUTHORIZED ON 160 METERS effective June 17. In its Report and Order on PR Docket 84-959, the FCC decided to permit the use of all three modes across the entire band, but cautioned that introduction of the new modes does not temper the possible reallocation of 1900-2000 kHz to radiolocation in Docket 84-874.

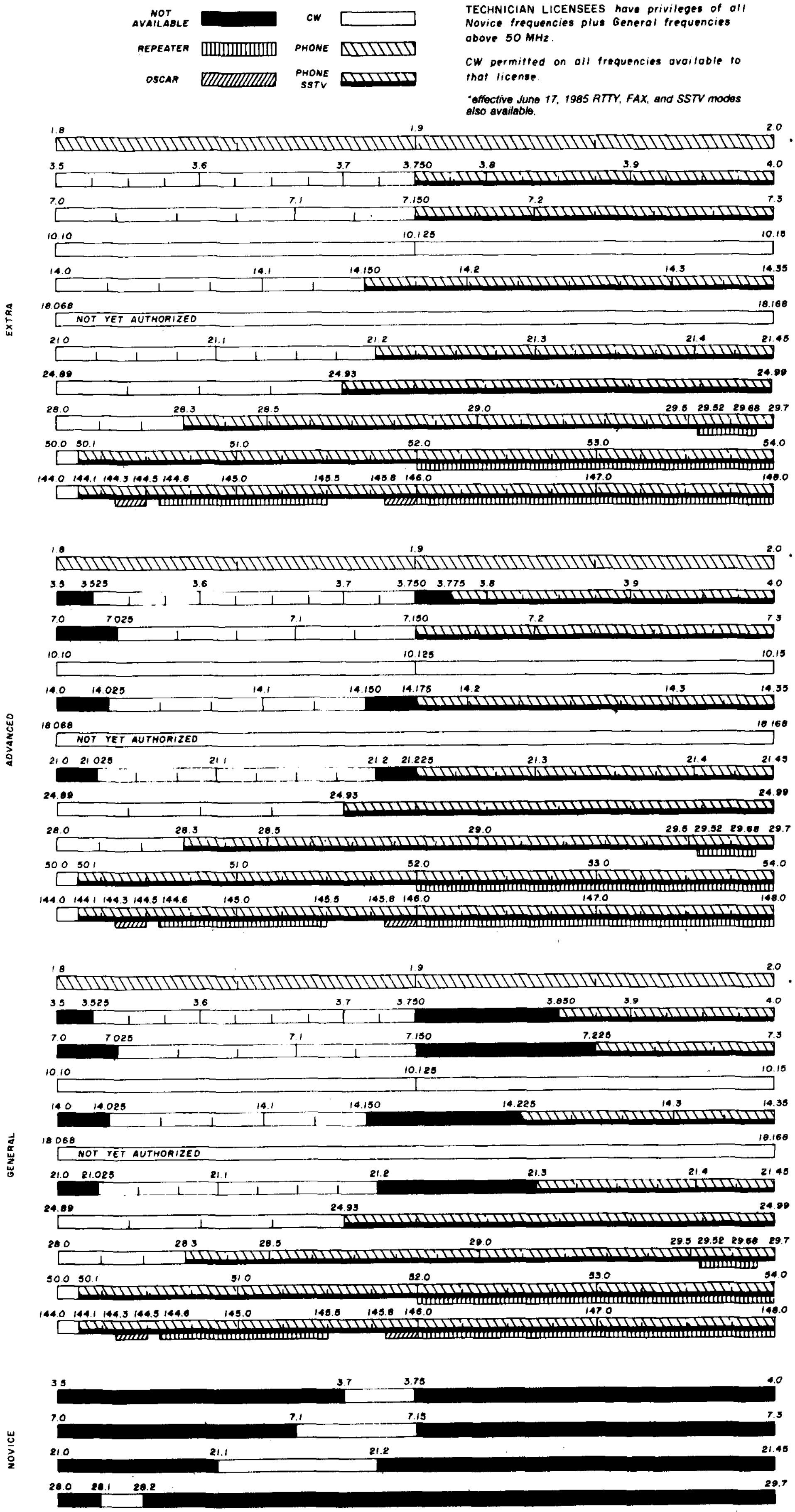
THE INDUSTRY GROUP THAT'S BEEN WORKING ON AMATEUR RADIO'S FUTURE had its second meeting in Dayton, the Thursday night before the Hamvention. About 40 industry representatives attended and heard the task force leaders report considerable progress on various promotional efforts. Travis Brann, WA5RGU, of Kantronics, succeeded Mike Lamb of AEA as de facto group chairman for the next quarter; Joe Schroeder, W9JUV, will continue to act as secretary/treasurer for the time being. A delegation from the group is scheduled to meet with Senator Barry Goldwater, K7UGA, for a briefing in early June.

The First Attempt At Implementing One Of The Group's Proposals Appears to have met with some success at the Rochester Hamfest in May. A good number of the free tickets sent to area junior high and high school teachers for distribution to interested students were used, and special booths aimed at entry level prospects were reported to be very popular.

The Average Age Of New Amateur Licensees In April was 36, the FCC determined after analyzing the approximately 2200 applications from never-before licensed applicants it received that month. The oldest was 82, the youngest 7, and the median age 35.

SOME FOUNDATIONS FOR A NATIONAL REPEATER COORDINATION SYSTEM were laid during the course of several well-attended meetings at Dayton. The first, organized by W8JRL (Ohio) and WB8UPM (Michigan), discussed the relative merits of 15 vs 20 kHz channel spacing, while the second was on the FCC's national repeater coordinator proposal, PR Docket 85-22. At that meeting ARRL Hudson Division Vice Director WA2DHF reported tentative League agreement to fund a computer system and incoming WATS line for coordinator use, and to publish a coordinator's newsletter. At the third session the consensus seemed to favor a "confederation" of area coordinators rather than a single national coordinator.

Frequency Spectrum Chart



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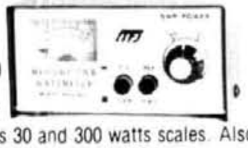

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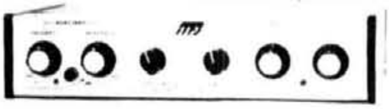

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comments

active antenna

Dear HR:

The article in May, 1985, issue of *ham radio* on active antennas ("Active Antenna Covers 0.5-30 MHz," by Peter Bertini, K1ZJH) was interesting but contained no evaluative data. Your readers might be interested in knowing that an evaluation of S/N performance of active antennas was published by Radjy & Hansen in the March, 1979, *IEEE Transactions on Antennas and Propagation*, Vol, AP-27, pages 259-261. S/N degradation occurs over the upper part of the HF band where external noise reduced by the impedance ratio is less than preamp noise. This degradation is aggravated by large design bandwidth since that requires a large impedance ratio.

Robert C. Hansen
Tarzana, California

On-the-air support

Dear HR:

I agree that we need an aggressive Junior High ham radio program — but we need actual on-the-air support just as badly, or maybe even more so.

A year and a half ago I was working with a 14-year old and a 13-year old. Those kids picked up code so fast I couldn't believe it. They were doing great on element 2. They weren't interested in Novice tickets — they wanted General Class licenses, and with some on-the-air support they would have made it.

I loaned them each a transceiver (Sans finals — hi!) so they could look around the bands for something of interest to them. I looked for contacts I thought would be interesting to them. They worked many contacts on my rig looking for teenage support. They didn't call it that, but follow-up conversations made it obvious they couldn't find anyone on the air that shared any interests with them.

Needless to say, we — the ham world — lost two bright youngsters for what I believe was lack of interesting QSOs for two teenagers. . . . Both of them turned to computers. About 300,000 people live in our metro area, so they now find lots in common with other kids on their computer nets. They're also interested in interfacing music synthesizers with their computers.

I've tried to get them back into Amateur Radio, but I can't compete with their age group. . . .

We're friends, and the three of us play golf together. I have a feeling that when they can beat me at golf, they'll be off to greater challenges — but for now, we share that interest.

Any ideas on how to hold their interest? The neighborhood is full of youngsters coming into their teens, and I'm willing to try again if all of us will try to share their interests when they're on the air.

Ken Uthus, KT7E
Nine-Mile Falls, Washington

CQ DXRC?

Dear HR:

I was very pleased to see your comments on courteous practices and the "rubber stamp" QSO ("Reflections," March and April, 1985). What made me lose interest years ago and still threatens is the fact that in *any* DX QSO, even from New England to Europe, which is a very solid circuit on almost any band with favorable propagation, you rarely find a conversation longer than a minute. Now I don't knock awards and contests — to each his own — but to me the fact that I have the capability, with my rig, and knowledge to exchange meaningful information with individuals in foreign countries is the most exciting and interesting aspect of Amateur Radio.

I don't ever wish to monopolize a DX station's attention when others are calling. But there have been many, many times I have worked a DX station who cut it very short only to call "CQ DX USA" two or three times before getting another QSO. This is frustrating to me, because my own definition of "rare DX" is the guy, wherever he is, who's willing to ragchew for a few minutes.

I suggest this happens because there is so much contest and certificate operation that the short QSO habit develops. Is there a way we can encourage both domestic and foreign stations to chew the fat for a few minutes when there aren't any pile-ups happening? Perhaps a new general call, like "CQ DXRC," which would imply that the caller isn't looking for the rare prefix, but rather a little international fellowship instead.

Anyway, I sure would like to see some movement in the direction of some of us getting to know each other, and I believe it can be done without jeopardizing the DX operators who are looking for their country totals. So often, in routine conditions, there are lots of Europeans working lots of Americans and nobody is finding out anything except "579 name is Bob tks 73 gb. . . . "

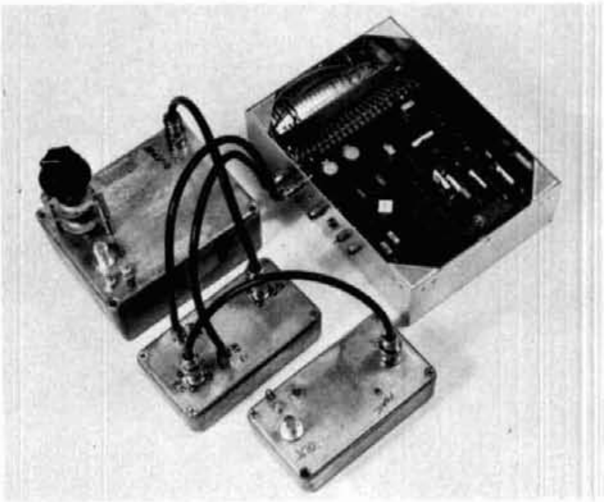
David Lewis, KA1KFC
(ex WA2ZQU)

OSCAR 10

Dear HR:

Many thanks for publishing "A PSK Telemetry Demodulator for OSCAR 10" (April, 1985, page 50). Why, I wonder, has it taken so long for this to appear in an Amateur publication?

Stephen E. Bach, AA4B
Scottsville, Virginia



2-meter transmitter
uses Weaver modulation

Try the "third method" of SSB generation

Imagine a 2-meter SSB transmitter that contains no crystal filters, no IF amps, no heterodyne oscillators, no BFOs, and no broadband audio quadrature generator, either.

Impossible? *No*. The scheme described herein is based on a little-known technique usually called the "third method" of SSB generation, which I prefer to call the "Weaver Modulator," in honor of D.K. Weaver, its apparent inventor. First discussed in 1956, the technique has rarely been seen in the commercial or Amateur press.[1]

The purpose of this project was to demonstrate that the Weaver modulation technique could be easily and inexpensively applied to direct conversion sideband generation at VHF frequencies. It was not my intention to build a full-function rig, but merely to experiment with the architecture; therefore, the design does not include any T/R switching, ALC circuitry, or digital frequency display. Intrepid homebrewers can easily add these functions themselves.

Despite the fact the "filter" technique of SSB generation has been almost universally adopted for Amateur and commercial design, the Weaver technique offers the following advantages:[2,3,4]

- Much of the circuitry operates at audio frequencies, where layout is relatively non-critical. Components for these applications are inexpensive and easy to obtain.
- There is only one RF oscillator, and it operates at the center of the transmitted output passband rather than being offset by an IF frequency. The oscillator may be tested with ordinary Amateur equipment; a 2-meter receiver can be used as a detector. Also, a conventional frequency counter can be used as a digital frequency readout, since there are no BFO or IF offsets to account for.
- All of the mixers operate on baseband signals. The absence of heterodyne techniques mean that there are (theoretically, at least) no images or spurs. Any out-of-band radiation is a result of mixer and amplifier nonlinearities, and not a result of any inherent limitations of the conversion scheme.
- Unlike the "phasing" technique, the Weaver modulator does not depend upon accurate phasing or balancing to achieve good control of the transmitter bandwidth. Phase and balance errors cause degradation of the audio quality only, not out-of-band components.
- No expensive or hard-to-find crystal filter is necessary. For the most part, no unusual components are required; the average junkbox probably contains most of the components needed for the design.

By Norm Bernstein, N1COX, 24 Foxfire Drive, Sharon, Massachusetts 02067

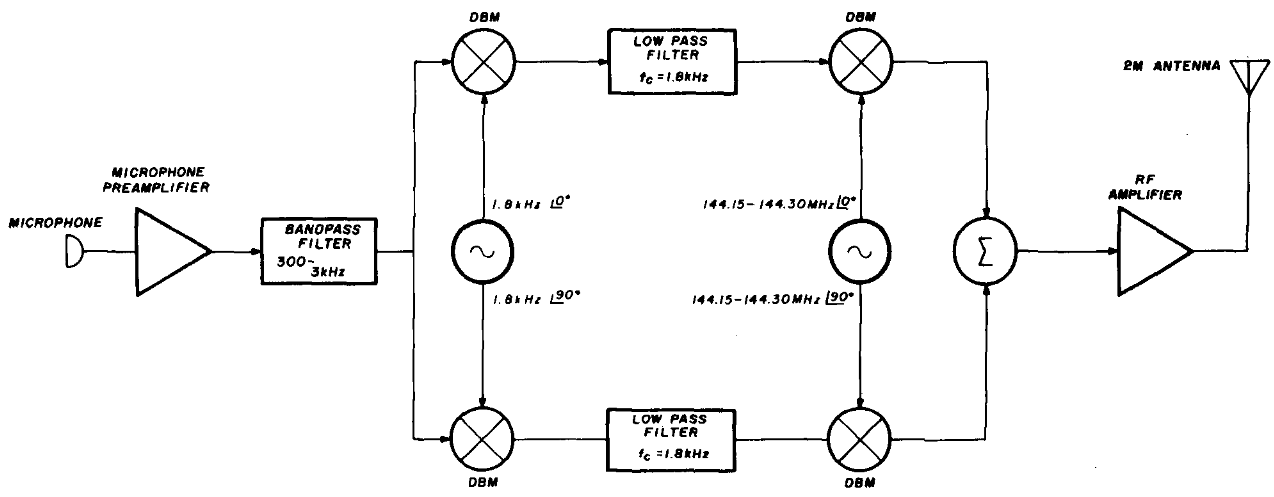


fig. 1. Block diagram of a single sideband transmitter using the Weaver modulation technique.

The only significant disadvantage of the Weaver modulator technique is local oscillator suppression. In a conventional SSB transmitter, any LO leakage is located at the position of the suppressed carrier, and a filter type receiver would normally be tuned to zero beat this signal for proper reception. In the Weaver modulator, however, the LO is set exactly in the middle of the transmitted passband, and good RF mixer balance is essential to avoid an unpleasant "whistle" on the transmitted signal. Fortunately, commercial DBMs have excellent balance characteristics, and the carrier leakage can be dealt with successfully. (Interestingly, this would not be a problem if the intended receiver used the Weaver technique as a demodulator, since the receiver's local oscillator would then zero beat with the transmitter's leaky LO signal, rendering the leakage inaudible.)

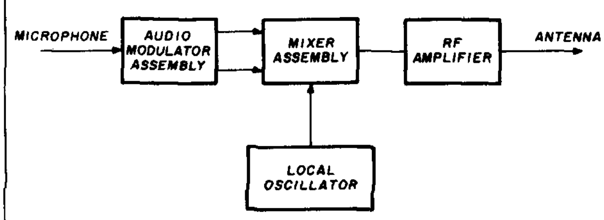


fig. 2. An audio modulator, mixer assembly, local oscillator, and post mixer amplifier comprise the modular construction design approach.

circuit description

Figure 1 shows a block diagram of the basic technique. The signal from the microphone is amplified and filtered for the normal 300 Hz to 3000 Hz communications bandwidth. It is then applied to a pair of double balanced modulators; the modulators are driven from an audio frequency local oscillator whose outputs are in quadrature. The AF local oscillator runs at 1.8 kHz, which is the center of the audio passband.

The outputs of the DBMs are then fed to a pair of low-pass filters, each with a cutoff frequency of approximately 1.8 kHz. These filters establish the basic transmitted bandwidth and are analogous to the crystal filter found in conventional rigs.

The outputs of the filters are then sent to another pair of double balanced mixers; these mixers are driven from a quadrature local oscillator operating at the desired RF frequency. The outputs of the mixers are then summed, with the resultant output being a single sideband signal. The signal may then be amplified in a conventional manner before being fed to the antenna.

Selection of the upper or lower sideband can be made by switching the phases of either of the local oscillators or by swapping the outputs of either pair of double balanced mixers.

While the actual technique might be difficult to understand, its mathematics are relatively simple. Rather than attempt a complete description of the mathematics at this point, I recommend that interested readers consult the references listed at the end of this article, especially the original paper by Weaver.

designing the prototype

To minimize leakage effects and simplify testing, I decided to split the design of the prototype into four functional blocks: the audio modulator (containing the microphone preamplifier, the audio double balanced mixers, the filters, and the AF local oscillator generating circuitry), the local oscillator, the RF mixer assembly, and the post-mixer amplifier. The audio modulator was housed in an aluminum chassis box, and the remaining three modules were constructed in separate die-cast boxes, using BNC connectors for signals and feedthroughs for DC power. Both **fig. 2** and the photo show the interconnection of the four modules.

The audio modulator assembly performs all the baseband signal processing, producing an output suitable for driving the RF mixers directly. This module has the most complex circuit of the four, but is the easiest to build because the layout is not critical; I used a conventional punched board with sockets for the ICs and point-to-point wiring.

The microphone input is connected to a wideband gain stage (**fig. 3**) in order to bring the audio signal up to the nominal working level (2 to 3 volts p-p). The signal is then fed to a highpass filter in cascade with a low-pass filter. These filters are implemented as third-order Sallen and Key types with cutoff frequencies of 300 Hz and 3 kHz, respectively.

The signal is now split into two paths. Each path consists of a double balanced mixer, followed by a relatively sharp low-pass filter, followed by a buffer stage and 50-ohm pad designed to deliver approximately 0 dBm to the mixers.

The double balanced mixers are implemented with a series/shunt switch (1/2 of a CD4016 CMOS switch) and an op amp configured as an "invert/non-invert" stage. This type of mixer exhibits good linearity and balance at audio frequencies, but has strong spurious response at harmonics of the local oscillator frequency; this is why the microphone preamplifier is followed by a relatively sharp bandpass filter.

The signals from the mixers are then routed to the low-pass filters. The filter characteristic is important

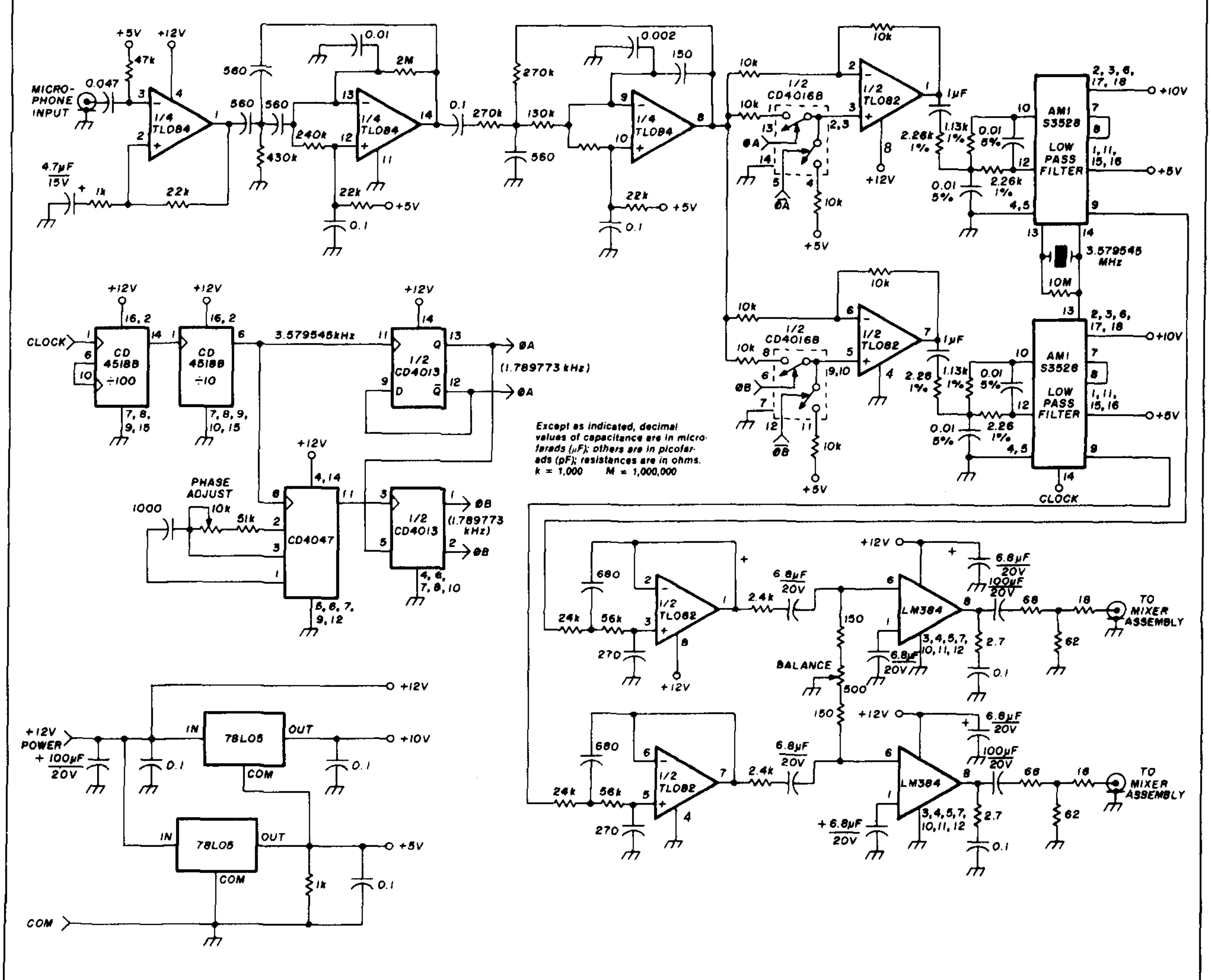
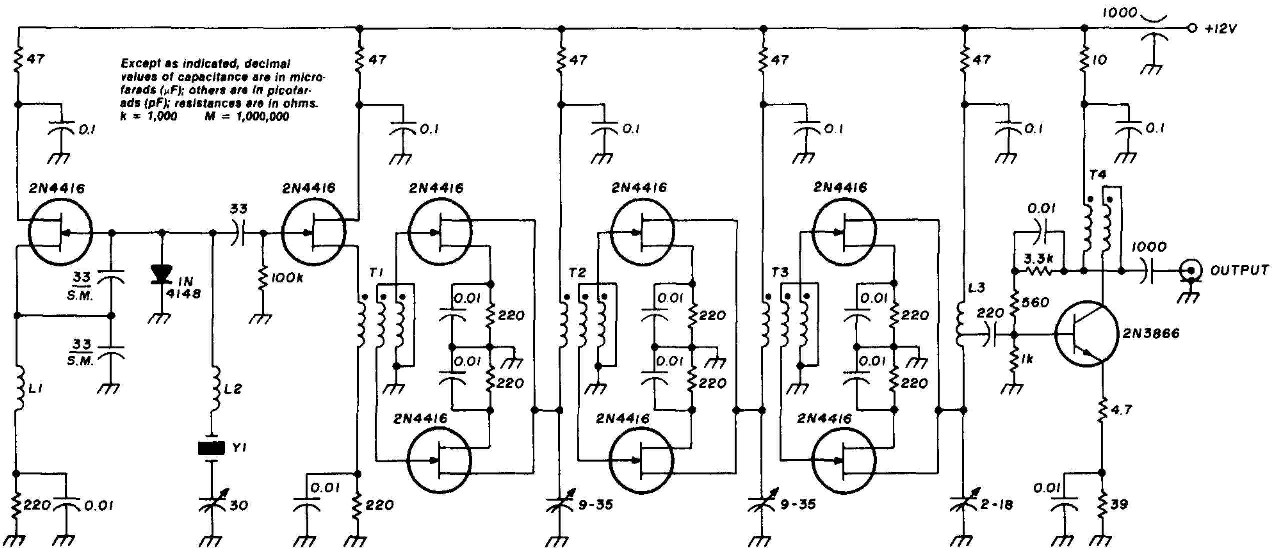


fig. 3. The audio modulator assembly consists of a microphone preamplifier and bandpass filter, a pair of double balanced mixers, and the switched capacitor filters. Also included in this assembly are the 1.8 kHz quadrature local oscillator and a pair of amplifiers for driving the RF mixers.



L1	33 turns No. 24 enameled, FT50-61 core
L2	35 turns No. 24 enameled, T50-6 core
L3	4 turns No. 18 tinned, 1/4" ID × 1/2" long tap 1/2 turn from cold end
T1	12 turns No. 30 enameled, trifilar on FT50-61 core
T2	11 turns No. 30 enameled, trifilar on T37-6 core
T3	7 turns No. 30 enameled, trifilar on T37-6 core
T4	5 turns No. 24 enameled, bifilar on FT37-61 core
Y1	18.025 MHz, parallel resonant, 20 pF load capacitance

fig. 4. The local oscillator is a VXO operating at 18.025 MHz followed by three push-pull doublers and an amplifier. The output is 144.150 to 144.300 MHz at about +17 dBm.

because it affects the degree of unwanted sideband suppression and establishes the bandwidth of the transmitted signal in much the same way that the crystal filter does in a conventional rig. What is needed here is a high order elliptical low-pass filter with good stopband performance. One additional requirement is that the filters in each of the two signal paths have closely matched amplitude and phase characteristics; any significant mismatch here will affect the unwanted sideband suppression (which, in a Weaver modulator, results in a degradation of the audio quality).

While the filters could have been built using conventional LC techniques, I decided to use a pair of switched capacitor filter ICs. This device the S3528 from American Microsystems, Inc.,* is a seventh-order elliptical low-pass filter with a programmable cutoff frequency and better than 50 dB worth of stopband suppression. A pair of these devices is significantly smaller than corresponding passive LC filters and are "tweak free" — i.e., they require no adjustment whatsoever and are inherently well matched. A minor disadvantage to switched capacitor filters is that they require some additional filtering at the input and some filtering at the output to remove the residual clock component from the signal, but this was not difficult to accomplish.

After the filters, the two audio signals go to a balancing network followed by a pair of LM384 driver amplifiers. These amplifiers are power devices capable of driving the 50-ohm pads used to reduce the signal to approximately 0 dBm, a level appropriate for the IF ports of the RF mixers. The heavy attentuation also helps to insure that the mixers see a broadband resistive termination at their IF ports, which is important for proper mixer operation.

The switched capacitor filters contain their own oscillator, which is based on a standard 3.579545 MHz colorburst crystal. This clock signal is divided by 1000 and applied to a pair of flip flops, one of which is delayed by an adjustable one-shot to create a 90-degree phase lag. The output of these two flip-flops is an adjustable quadrature signal operating at 1.789773 kHz, which is close enough to the design value of 1.8 kHz for suitable operation. Feedback from the non-delayed flip-flop is employed to insure consistent phasing at startup; without such feedback, the

*American Microsystems, Inc., a division of Gould, Inc., 3800 Homestead Road, Santa Clara, California 95051.

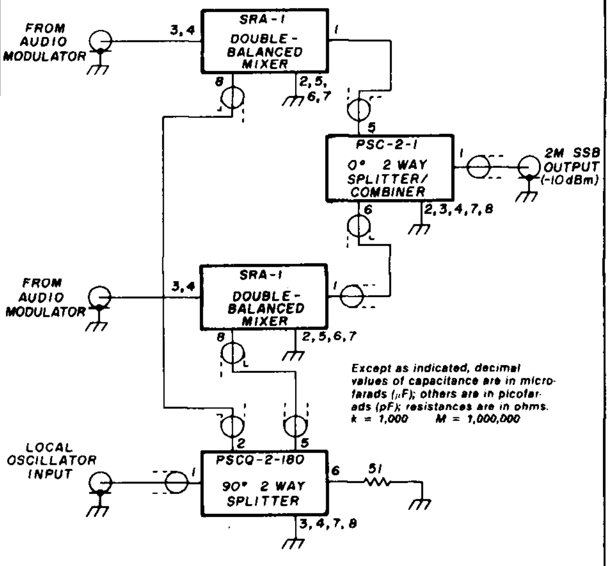


fig. 5. The mixer assembly contains two SRA-1 double balanced mixers, a 90-degree 2-way hybrid (which is used to create the quadrature local oscillator signals for the mixers), and 0-degree, 2-way hybrid, which sums the two mixer outputs into a single SSB signal.

transmitter would choose upper or lower sideband at random!

The AF local oscillator quadrature could have been generated with perfect accuracy through the use of flip-flops alone, but I used the one-shot delay in order to allow for some adjustment range; it can be shown mathematically that small phase errors in the RF mixer assembly can be cancelled by introducing an equal but opposite phase error into the system at the AF mixers.

The RF local oscillator (fig. 4) is a VXO running at a nominal frequency of 18.025 MHz, followed by three doubler stages and a buffer stage. This design is simple to build, adequately stable, and provides for enough tuning range to cover most of the portion of the 2-meter band commonly used for terrestrial communications. My version covers 144.150 MHz to 144.300 MHz; it is possible to obtain a wider coverage, but tuning ranges in excess of 0.1 percent of the nominal output frequency will result in reduced stability.

Although no frequency indicator was constructed for this experimental rig, it would be relatively easy to build one because the oscillator runs at the transmitted frequency; there are no IF or BFO offsets to account for. A general-purpose frequency counter capable of operation at 2 meters can also be employed.

The RF mixer module (fig. 5) consists of a pair of SRA-1 mixers whose local oscillator inputs are driven in quadrature, and whose RF outputs are summed into a single output. The local oscillator drive is obtained from a commercial quadrature hybrid, in this case the PSCQ-2-180 from Mini-Circuits Labs.* The summation of the RF outputs is accomplished with a hybrid combiner (model PSC-2-1). The two audio drive signals are connected directly to the IF ports.

A post mixer amplifier is used to provide 30 dB gain to the −10 dBm 2-meter SSB signal output of the mixer assembly. This results in a signal of about 100 milliwatts, which is sufficient for on-the-air testing. This amplifier (**fig. 6**) is a three-stage device with a grounded gate FET followed by two broadband bipolar class A stages. Because of the relatively low power, I did not incorporate any further filtering of the signal; more would undoubtedly be incorporated, however, in a practical design.

test results

This experimental rig was tested on the air in order to get some subjective feedback on the audio quality. The estimated output power was 50 to 100 milliwatts, too small to be accurately measured on any of my test gear. My first QSO was with W1VDI in Providence, Rhode Island, about 30 miles from my QTH. I received a Q5 report.

Listeners generally reported that the audio quality was essentially equivalent to that of my regular 2-meter SSB rig (an ICOM 251A); minor differences in tone quality were attributed to the use of a different microphone. None of the test participants reported any trace of carrier leakage on the signal, which indicates that the carrier balance of the mixer assembly is adequate.

The only negative comment from the test participants was that there was a brief (2 to 3-second) period immediately after I keyed the transmitter each time, during which some traces of carrier could be heard; this effect "died out" within a few seconds. This was found to be caused by DC bias level settling in the audio modulator section; it can be avoided by maintaining continuous power to the audio modulator rather than attempting to switch the modulator power when the transmitter is keyed.

The transmitter was later examined with an RF spectrum analyzer and found to exhibit a carrier suppression of better than 45 dB, with the reverse sideband component down at least 30 dB from maximum output.

the Weaver technique as a receiver

The Weaver technique is bilateral. If all of the elements can be constructed to operate bilaterally (**fig. 1**), then the system can be used to demodulate SSB signals as well as generate them. Although I have not had a chance to experiment with receive applications, it seems to me that many of the advantages of this technique apply in a demodulation system as well. Images and spurs would be far less of a problem than

*Mini-Circuits Labs, Inc. 2625 East 14th Street, Brooklyn, New York 11235.

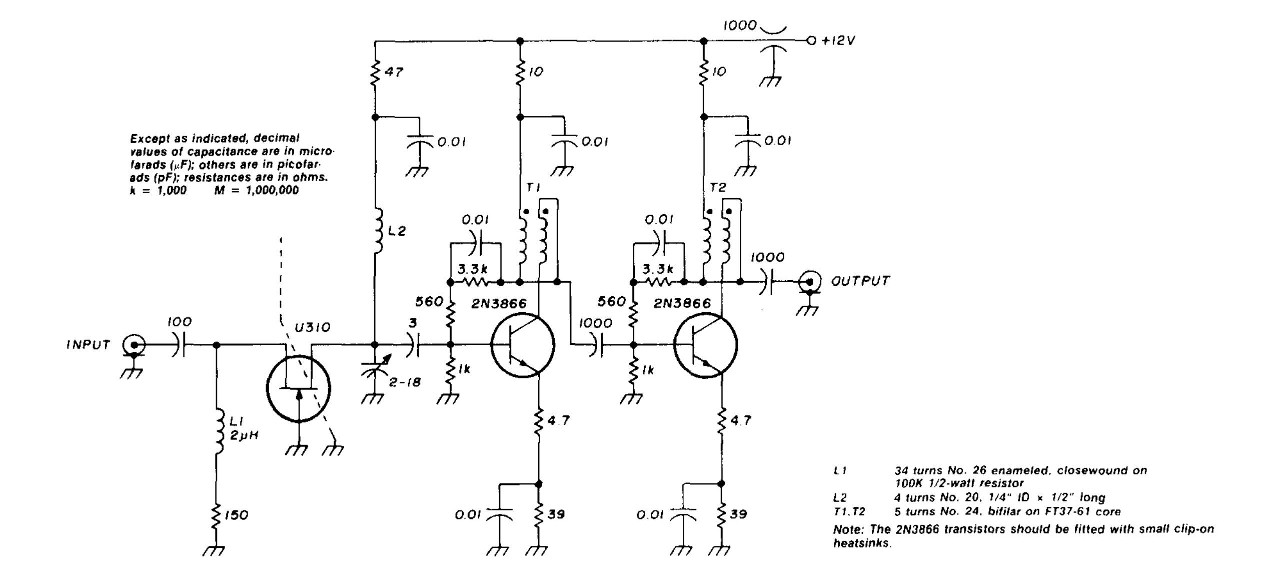


fig. 6. The post mixer amplifier provides about +30 dB of gain at an output of approximately 100 milliwatts.

in conventional heterodyne architectures. Dynamic range should be quite good, since conversion and demodulation occur in the first stage without the need for IF amplifiers, which can overload. All of the gain (with the exception, perhaps, of some RF amplification before the first mixer pair) would be accomplished at audio frequencies, where recent advances in IC processing techniques make low noise audio amplification relatively easy.

low cost variations

It should be possible to reduce the cost of this design by substituting components in the RF mixer assembly and the audio filters. The hybrid combiner and 90-degree splitter could perhaps be replaced by Wilkinson dividers (made from two 1/4-wavelength sections of 75-ohm cable, joined at one end) and a 1/4-wavelength section of 50-ohm cable for the phase delay. The cable scheme would probably have enough bandwidth and accuracy for 2-meter SSB operation, especially in view of the relatively narrow bandwidth popularly used on 2-meter SSB. Precise measurement of the cable lengths would not be necessary, since small amounts of phase error can be "tuned out" with the phase adjustment in the audio modulator section.

The audio filters need not be quite as sophisticated as the ones used in the prototype design; the switched capacitor filters could be replaced with equivalent LC designs. The differential phase performance of the two filters is important, however, for good reverse sideband suppression; it will therefore be necessary to measure the component tolerances of the Ls and Cs quite carefully.

special consideration

Any practical application of the Weaver modulator will require some special design consideration. For example, when using the prototype transmitter in conjunction with a conventional "filter type" receiver, leakage from the transmitter's local oscillator would overload the receiver front end during reception. One way to minimize this problem would be to disable the VXO multiplier stages during receive. In the interests of stability, however, it would not be advisable to key the VXO itself.

acknowledgements

I would like to thank W1VDI, K1TOZ, and WA9WTK/1, all of whom participated in the on-the-air testing phase of this project. I would also like to thank Ed Wetherhold, W3NQN, for his advice on the subject of audio filters.

references

1. Donald K. Weaver, "A Third Method of Generation and Detection of Single-Sideband Signals," *Proceedings of the Institute of Radio Engineers*, December, 1956, pages 1703-1705. (This issue was a landmark for SSB development, as it contains a number of now-famous articles, including the well known Norgaard articles on the phasing technique of SSB generation and detection.)
2. Howard F. Wright, "The Third Method of SSB," *QST*, September, 1957, pages 11-15.
3. J.F.H. Aspinwall, "The Third Method — A New System of SSB Generation," *Wireless World*, January, 1959, pages 39-43.
4. Herbert Krauss, et al, *Solid State Radio Engineering*, John Wiley and Sons, 1980, pages 233-234.
5. Joseph Sansone, "Get High-Q in Active Bandpass Filters with a Quadrature Modulation Scheme," *Electronic Design*, November 8, 1978, pages 124-127.

ham radio

VCO tunes from 1800-2600 MHz

New to Microwaves? Build and test this simple VCO

I have built antennas, preamplifiers, filters, mixers, and oscillators for microwave frequencies from 23 to 4.8 cm. All performed as expected except for the oscillators, which required multiplication of the fundamental for the 13-cm band. Some required considerably more multiplication because the fundamental frequency was as low as 15 MHz. The oscillator/multipliers were complicated — difficult to build and even more difficult to test. They produced fundamental output, multiplied output at undesired harmonics, and often spurious output. To avoid these problems, I decided to build a fundamental voltage controlled oscillator (VCO) that operated directly on the 13-cm band.

This simple VCO was easy to build and test. The tuning range, power output (2 to 15 mW), phase noise, and stability of the VCO were acceptable for many applications.

The parts for the VCO can be purchased from dealers or mail order suppliers for a total of less than $20. If all the parts for the VCO are available, including the etched PC board and test equipment described below, the VCO can be built and tested in an hour, using standard tools. A mounted low-power magnifying glass is a helpful accessory.

I built a line stretcher and microwave detector for testing the VCO, using the line stretcher to determine the approximate frequency and the detector (with a milliammeter) to measure the power output.

I've used the VCO as an FM transmitter and as a local oscillator for a converter for broadband (greater than 100 kHz) communication. Since the VCO is remotely tunable, it can be conveniently mounted at the antenna feed, thus eliminating line losses for either transmission or reception.

background

While searching for a suitable circuit for a fundamental 13-cm oscillator, I found a very simple WWII era oscillator circuit in the 1949 *Radio Amateur's Handbook*. This circuit used two 6J6 tubes with a transmission line connected to the plates of the two tubes. Oscillation was at 420 MHz. The only way the 6J6 could be made to oscillate at such a high frequency was to divide the shunt capacitance load on the transmission line by 2, using 2 tubes. The cathodes and plates of the tubes were isolated from RF ground with RF chokes, and the grid grounded through a bias resistor. Oscillation occurred because of coupling between the two sides of the common plate transmission line.

I built this same circuit on a PC board, but used two microwave transistors in place of the 6J6 tubes and spiral wound carbon film resistors as RF chokes. Using transistors in place of the tubes allowed tuning over a wide frequency range since the junction capacitance of the transistors is easily varied by changing the base to emitter current. **Figure 1** shows the circuit for this simple VCO.

Capacitance of a dual 6J6 from grid to plate is about 3 to 4 pF. Bipolar microwave transistors available today have C_{OB} of 0.4 pF. This should allow oscillation at frequencies as high as 6 GHz with a significant portion of a transmission line external to the transistors. This VCO circuit actually has the base grounded so capacitance in the transistor is higher than 0.4 pF.

Any transistor with a C_{OB} less than 0.5 pF, a DC Beta greater than 25, and F_T greater than 4 GHz would probably operate properly in this circuit. Transistors such as MRF901, BFR90, HXTR-61, and HP 35821B could be used, although the maximum frequency of operation might be lower.

I used the NE21935 in the VCO because it costs less than $7.00, is bipolar, has a convenient package form with two emitter leads, is very small, and has excellent C_{OB} and F_T specifications. The NE21935s are available

By **Hans M. Roensch, Jr., WØDTV**, R.R. #1, Box 156B, Brookfield, Missouri 64628

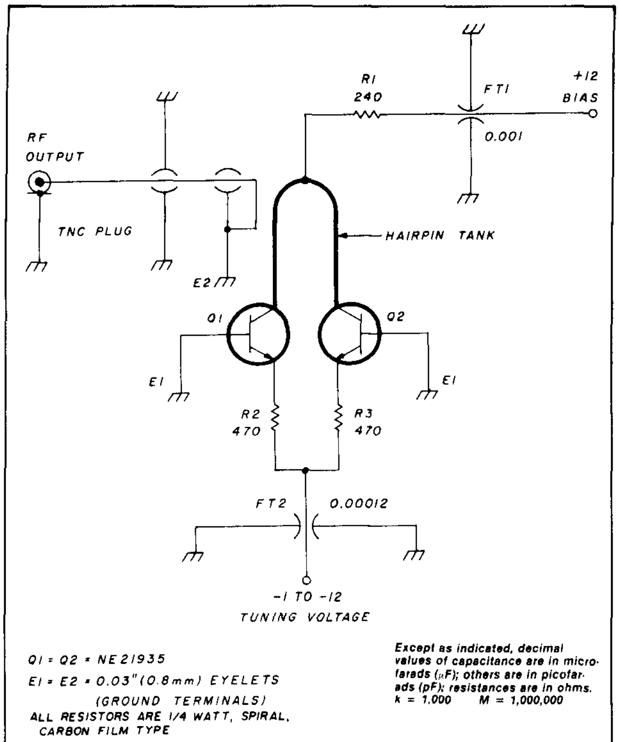


fig. 1. Microwave voltage controlled oscillator circuit diagram.

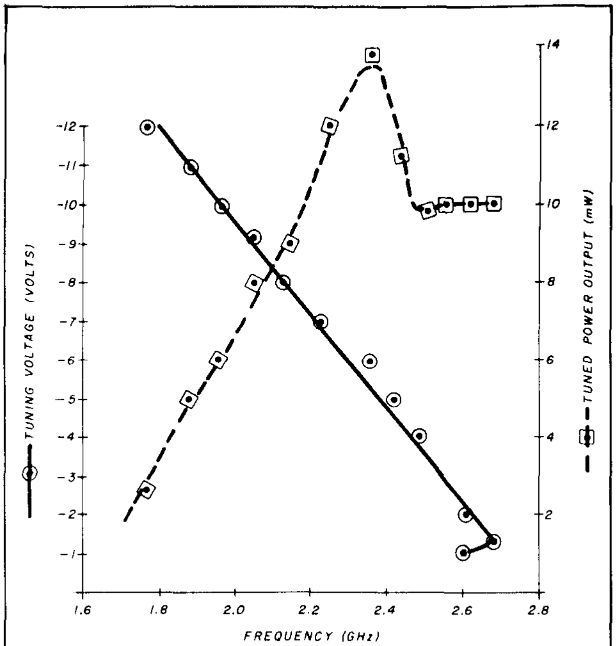


fig. 2. Typical tuning voltage versus frequency and tuned power output versus frequency. Maximum power output occurs when the tuning voltage is between −1 and −7 volts. Tuning is almost a linear function of voltage.

from California Eastern Laboratories, 3005 Democracy Way, Santa Clara, California 95050 or from one of their sales offices.

design specification

Because $V_{COB\ MAX}$ for the NE21935 is 20 volts, 12 VDC power supplies were selected for use with the VCO. The absolute maximum current allowed through the NE21935 is 80 mA. To protect the transistors thermally and provide a wide tuning range, (50 mA, or about 25 mA per transistor,) was selected as the maximum current.

The maximum power dissipation for the NE21935 without case cooling is 390 mW at ambient temperatures up to 50 degrees C (122 degrees F). Since the VCO has an output of 2 to 15 mW with about 50 mW dissipated power, more output is possible at the sacrifice of thermal drift and tuning range. About 25 percent more power output results if the bias voltage is increased to 18 volts. However, tuning range is reduced to about 300 MHz.

Required output power to most mixer diodes is in the range of 5 to 10 mW. Therefore, I wanted at least 10 mW output from the VCO. This power, adequate for communication over a few miles or as excitation power, is easily detectable for test purposes. **Figure 2** shows a typical power output versus frequency plot for the VCO.

I wanted the tuning range of the VCO to be wide enough to cover the entire 13-cm band plus 100 MHz or so on each side, so that a 100 MHz first IF amplifier (FM receiver) could be used in the receive mode. The actual tuning range for VCOs I have tested has been greater than 800 MHz, although when the oscillator is delivering more than 10 mW of power the tuning range decreases to 500 MHz.

I wanted the VCO to have minimum possible phase noise and good stability without generating spurious outputs. To help reduce phase noise the VCO was built on teflon fiberglass PC board and the "hairpin" transmission line was mounted off the PC board with air as the dielectric. The low transistor *Q* and low hairpin *Q* would tend to cause high phase noise at this frequency. The VCO should be used in broadband applications only. Spectrum analysis using a homebrew analyzer has shown noise and spurious outputs at least 20 dB below the fundamental.

The shunt capacitance of the tuning voltage circuit was limited to 120 pF to allow for the possibility of modulating the VCO by video signals at a later date.

To prevent stray microwave energy in the shack, it was necessary to enclose the VCO. To help prevent holes or resonances in the tuning range, the enclosure must be less than a quarter wavelength in size in all directions at the highest frequency of oscillation. Because microwave energy can leak through very small cracks in the enclosure, I decided to completely enclose the VCO in a copper housing, seam soldering all gaps except where the two feedthrough capacitors and the RG-58 coax enter.

The output is closely coupled to the hairpin tank transmission line and therefore high *Q* and/or mismatched loads at the output may cause tuning holes or resonances. Changes in load will also cause shifts in frequency.

acquiring the parts

The 0.03 inch (0.76 mm) thick, 1 ounce (28 gram), double-sided teflon fiberglass PC board, the eyelets, feedthrough capacitors, and copper foil were purchased from Gateway Electronics, 8123-25 Page Boulevard, St. Louis, Missouri 63130; Surplus Sales, Inc., 2412 Chandler Road, East Bellevue, Nebraska 68005 also stocks needed items. Any value of feedthrough capacitor between 50 and 1000 pF can be used, depending on desired maximum modulation frequency and allowable RF leakage. Standard epoxy fiberglass PC board could probably be substituted for the teflon fiberglass PC board, but some degradation in maximum frequency and some reduction in *Q* might be expected. All other parts and materials can be obtained from local or mail order dealers.

construction

I use a 20 to 30-watt soldering iron, a 100 to 200-watt soldering iron, a thin track saw (available from model railroad hobby shops), a tubing cutter, rosin core solder, long nosed and Vise-Grip® pliers, a hand drill, a small sharp knife, tin snips, a small heatsink clip, and a low-power magnifying glass for construction. All parts except the PC board, eyelets, the transistor leads, and the copper foil are tinned before soldering. Construction proceeds in this order:

- Prepare the PC board with cut out and eyelets.
- Solder the transistors and "hairpin" to the PC board.
- Install the feedthrough capacitors, resistors, and coax.
- Test the VCO for proper operation.
- Solder the VCO into its enclosure and retest.

The foil pattern shown in **fig. 3** is used as the negative to expose a piece of photosensitized 0.03 inch (0.76 mm) thick teflon-fiberglass PC board. The back side of the PC board (the bottom of the enclosure) is covered to prevent etching it away and used as a ground plane. (If you don't have the facilities to etch your own PC board, the etched PC board with eyelets can be obtained from Roensch Microwave, RR #1, Box 156B, Brookfield, Missouri 64628. The price is $5.00, postpaid.)

The PC board is drilled for the eyelets and feedthrough capacitors approximately as shown in **fig. 4**. Locate the holes within 0.1 inch (2.5 mm) of the locations shown so that the entire hole remains at least 0.05 inch (1.3 mm) from the edge of the PC board.

Cut out the space for the hairpin 0.3 inch (8 mm) deep by 0.4 inch (10 mm) wide and then install the two eyelets (or two pieces of 20 gauge wire) for grounding points. Clean the PC board with a non-phosphate cleanser and avoid touching it until all soldering is complete.

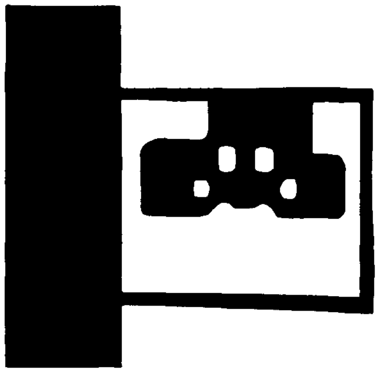


fig. 3. PC board foil pattern (actual size).

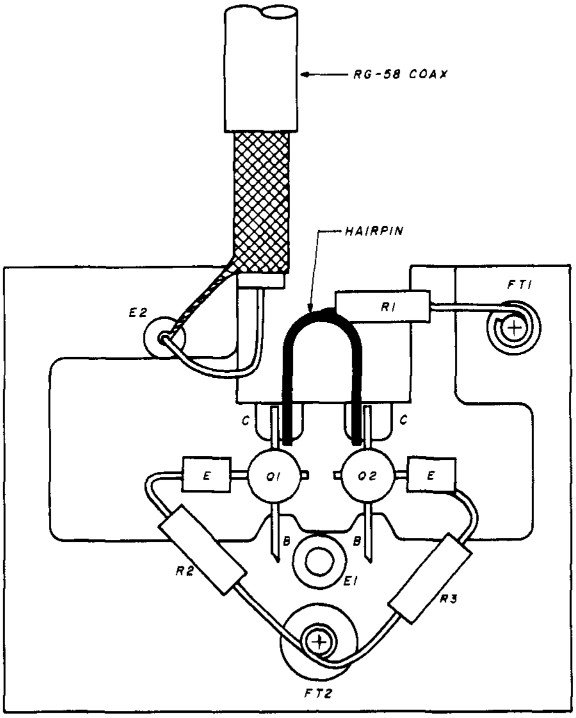


fig. 4. PC board with feedthrough capacitor holes, eyelets installed, and "hairpin" cutout.

Next, install the transistors. (The base lead of the NE21935 is identified by the 45-degree angle of its termination.) The lead opposite the base lead is the collector and the other two leads connect to the emitter. Cut one emitter lead (the opposite emitter lead on each transistor) as short as possible so that the transistors can be mounted close to each other with both base leads pointing in the ground direction as shown in **fig. 5**. With a drop of solder on the tip of a clean, hot 20 to 30 watt soldering iron, place the first transistor on the PC board. While holding a base lead in place with a finger, place a drop of solder on the collector lead and PC board solder pad tacking the lead in place. Make a good solder joint at the other two transistor leads. Then remelt the solder and add a little solder at the collector, base, and emitter to make a good, shiny buildup with adhesion of solder sufficient so no copper shows at all three transistor leads. Do not apply heat at transistor leads for longer than 3 seconds without a long cool-off period. Install the second transistor in the same manner with its cut-off emitter lead about 0.02 inch (0.5 mm) from the other transistor's cut-off emitter lead. The emitter leads must be close but must not touch each other.

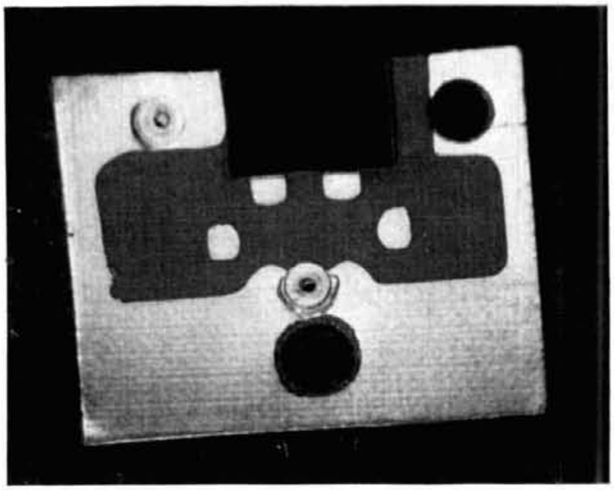


fig. 5. Location of parts on PC board. "Hairpin" is mounted over hairpin cutout. 240-ohm resistor is mounted above hairpin head inside outline of PC board.

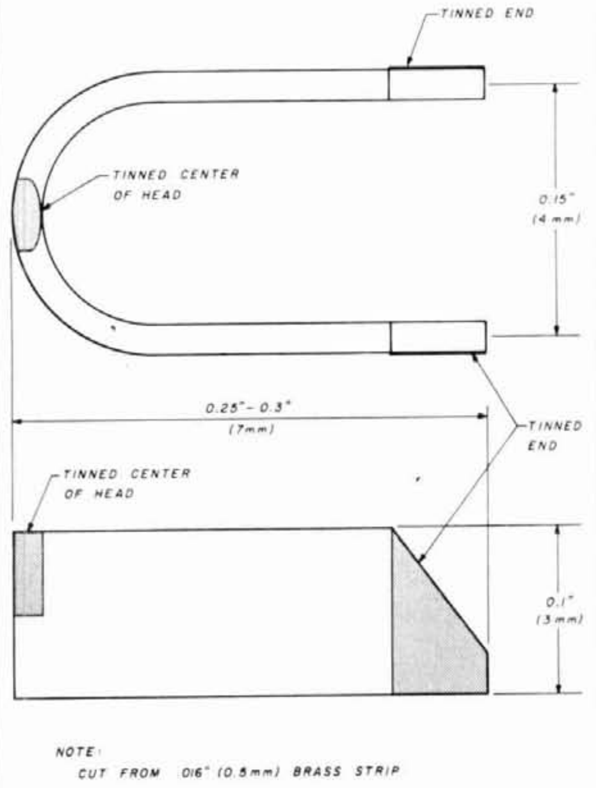


fig. 6. "Hairpin." Areas to be tinned prior to installation are shown.

Cut and bend the hairpin next. I used tin snips to cut a piece of 0.016 inch (0.4 mm) thick brass 0.1 inch (2.5 mm) wide by 0.7 inch (18 mm) long. Bend this piece of brass into its proper shape (**fig. 6**) using long-nosed pliers and your fingers. I make two diagonal cuts at the ends of the hairpin with small diagonal pliers. The sides of the hairpin should be of equal length. Hold the hairpin with Vise-Grip® pliers and tin the outside of each end and the head of the hairpin. A mounted low-power magnifying glass was used for this tinning and for soldering the hairpin to the PC board. Hold the hairpin with a pair of long-nosed pliers in position as shown in **fig. 5**, with the head of the hairpin 0.2 to 0.25 inch (5 to 6 mm) from the PC board. Reheat the solder at one hairpin end and one collector lead securing the hairpin to the PC board. Place a heatsink clip at the head of the hairpin. Then reheat and add solder at the second hairpin end making a solid solder bridge there. Go back to the first hairpin end and add a little solder to make a good solder bridge there also.

The feedthrough capacitors and eyelets are now soldered on both sides of the PC board. Make sure the 0.001 μF feedthrough capacitor is not mounted at an angle; if it is, it could short to the enclosure when it is installed.

Bend one lead of the 240-ohm resistor at a right angle as close to the body of the resistor as possible. Cut this lead to about 0.1 inch (3 mm) leaving the other resistor lead uncut. Use the second resistor lead to hold the resistor while soldering the short lead. (I placed a heatsink clip across the ends of the hairpin and held the resistor at a right angle to and vertically above the hairpin and well inside the outline of the PC board as shown in **fig. 5**.) With the drop of solder on the 20 to 30 watt soldering iron, solder the short resistor lead to the center of the head of the hairpin. The long lead of the resistor should be held against the

0.001 μF feedthrough capacitor while the short lead is soldered. Wrap, cut off, and solder the long lead to the 0.001 μF feedthrough capacitor.

Prepare the two 470-ohm resistors in the same way described for the 240-ohm resistor. Solder the short leads of these two resistors to the emitter leads of the two transistors as shown in **fig. 5**. Wrap, cut off, and solder the long leads of these resistors to the 120 pF feedthrough capacitor.

Prepare a 6-inch (152 mm) piece of RG-58 coax as shown in **fig. 7**, soldering the junction of the shield and center conductor of the coax to the eyelet on the PC board with the pickup loop about 0.02 inch (0.5 mm) from the hairpin as shown in **fig. 5**. The center conductor of the coax must not touch the hairpin. Install a BNC plug on the other end of the coax.

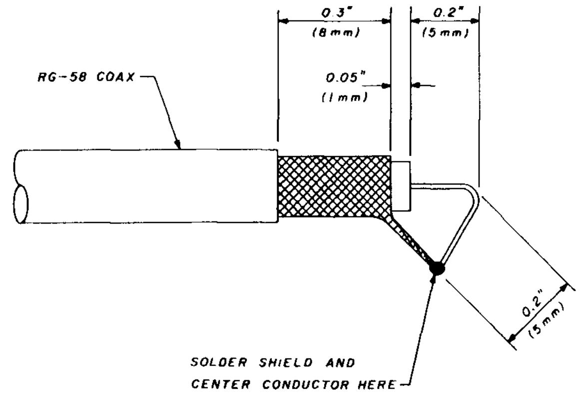


fig. 7. Detail of RG-58 coax pickup loop. Center conductor and shield are soldered together and then soldered to eyelet on PC board.

installing the VCO

Test the VCO as described below. Then cut and bend the enclosure and solder the VCO into it. Cut a piece of 0.02 inch (0.5 mm) flashing copper with tin snips as shown in **fig. 8**. Holding the flat pattern firmly with Vise-Grip® pliers, drill the mounting holes and the hole for the coax. Then cut the copper to make the hole for the coax into a slot.

Cut out a small wooden block 1 × 1.25 × 6 inches (25 × 32 × 156 mm) to use as a jig over which the flat pattern can be bent into a box. Make sure the flat pattern is bent upward because the hole for the RG-58 coax will be on the wrong side if it's bent downward.

Place the tested VCO (PC board) upside down on the bottom of the copper enclosure with the coax in its slot. Tack-solder the PC board in its proper position, placing small pieces of copper foil over the hairpin cutout area and across all gaps between the PC board and the enclosure. Make sure the foil over the hairpin cutout is flat and away from the hairpin. The RG-58 shield should be soldered to the foil and the foil soldered to the enclosure all around. (Do not move the coax until after the enclosure is cool.) The foil can be soldered to the PC board with a 20 to 30 watt iron and to the enclosure with a 100 to 200 watt soldering iron. The completed VCO, ready for final test, is shown in **fig. 9**.

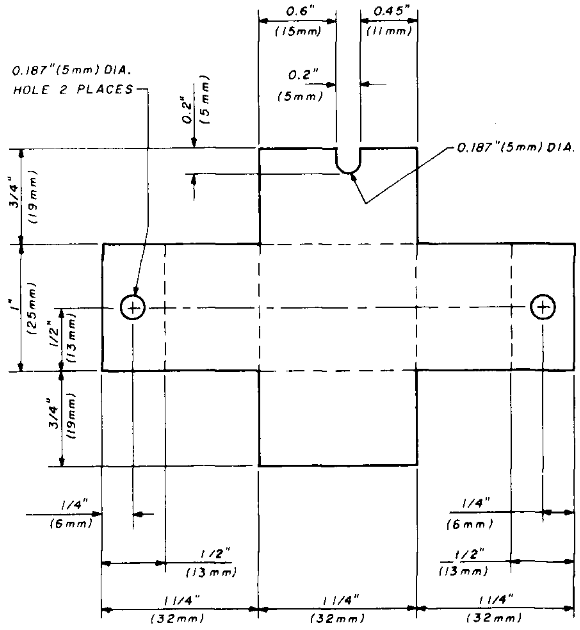


fig. 8. Flat pattern for enclosure uses 2.5 × 3.75 inch (64 × 95 mm) piece of 0.02 inch (0.5 mm) thick copper flashing material.

test equipment

A line stretcher is used to determine the approximate frequency; a detector/milliammeter is used as a power indicator. The line stretcher and diode detector can be built as described below.

Use four brass tubes and two teflon-insulated BNC receptacles to make the line stretcher (**fig. 10**). A tubing cutter is used to provide the lengths shown. Place the factory-cut ends of the tubing toward the center of the line stretcher. Slot the larger inner tube and larger outer tube with the track saw at one end in four places (two slots at a time) 90 degrees apart about 1/2 inch (13 mm) deep. Two holes, 5/8 inch (16 mm) and 1/4 inch (6 mm) drilled into a block of wood either nailed down or held in a vise can be used as a jig to hold the tubing while the slots are sawed. This protects the hand holding the tubing in case the thin, sharp track saw slips off the end of the tube. Squeeze the small tubes at their cut ends so that they fit tightly over the center contacts of the BNC receptacles and then solder them in place. Saw the larger

outer tube at the end (with four slots) that you cut with the track saw.

Squeeze the large tubes together uniformly at a slotted (cut) end until the tubes fit tightly over the tinned outer threaded portion of the rear of the BNC receptacles. Then holding the small tube in the center of the larger tube, solder the larger tubes to the threaded portion of the rear of the BNC receptacles.

Gently squeeze the larger inner and outer tubes together so that they fit the smaller inner and outer tube tightly as they are telescoped together. Wipe the outer tube with alcohol to help maintain good electrical contact between the outer tubes.

Build the detector as shown in **fig. 11**. Apply heat for no longer than 5 seconds when soldering the diode. The diode should be tinned at the two solder points before soldering it in place. Keep the leads on the 3-6 pF capacitor and diode as short as possible. The best capacitor to use is one with no leads at all, fabricated from PC board. A piece of 0.03 inch (0.76 mm) thick, double sided teflon/fiberglass PC board 0.3 × 0.3 inch (8 × 8 mm) makes an excellent bypass capacitor for 13-cm microwave frequencies. After the BNC receptacle threads and the PC board are tinned, solder one side of the PC board directly to the BNC receptacle. Heat the receptacle with the 100-watt soldering iron, then quickly solder the bottom side of the PC board to the receptacle with the 20 to 30-watt soldering iron. Then solder the diode in place between the other side of the PC board and the center contact of the BNC receptacle. Commercial 3 to 6 pF capacitors will work but output from the detector will be less. If you desire, the completed assembly can be embedded in silicone caulk to help prevent handling damage, but doing so will reduce output from the detector.

Other types of UHF/microwave diodes may be used if their junction capacitance is less than 1 pF. The HP5082-2835 diode is available from Radio Shack (Part No. 276-1124). 1N21 or 1N23 diodes are available from MHz Electronics, 2111 W. Camelback Road, Phoenix, Arizona 85015.

testing

The overall test setup is shown in **fig. 12**. I keep the RG-58 cables less than 6 inches (150 mm) long because RG-58 is very lossy at 13 cm. With the tuning voltage adjusted to a preliminary setting of −5 VDC, adjust the line stretcher for a minimum reading on the milliammeter. Mark this position on the smaller outer tube of the line stretcher with a felt tip pen. The line stretcher is then adjusted longer to the next minimum as indicated on the milliammeter and the smaller

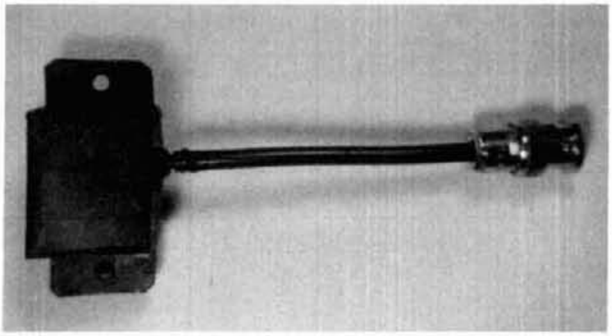


fig. 9. The completed microwave VCO.

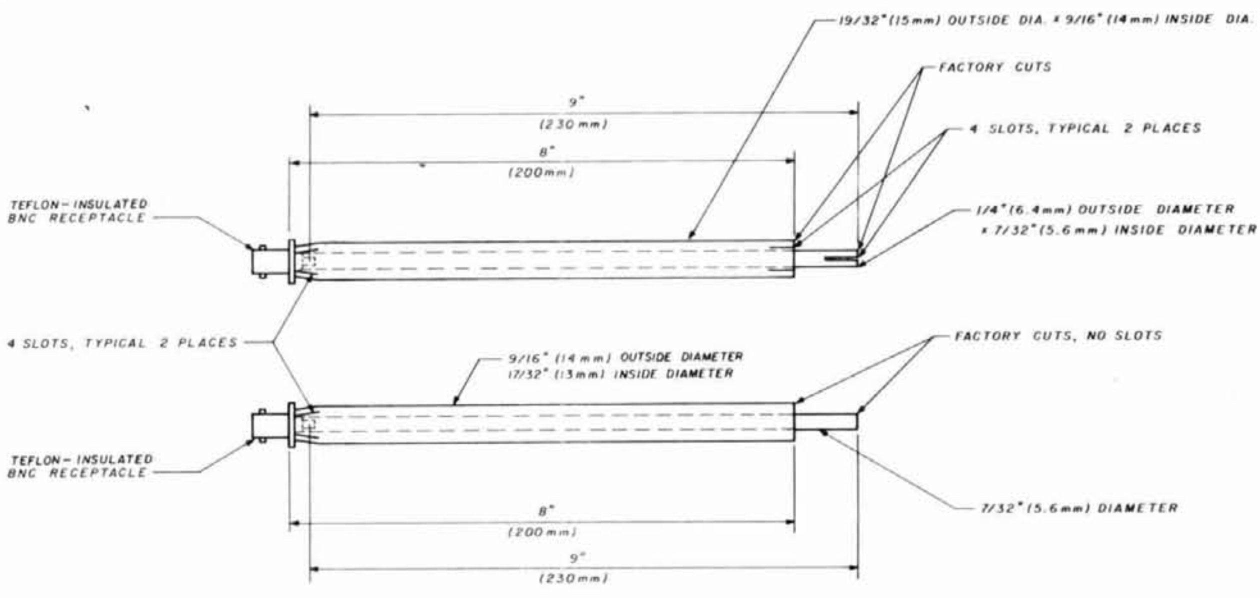


fig. 10. The line stretcher is built from four 0.016 inch (0.4 mm) wall brass tubes and two BNC receptacles.

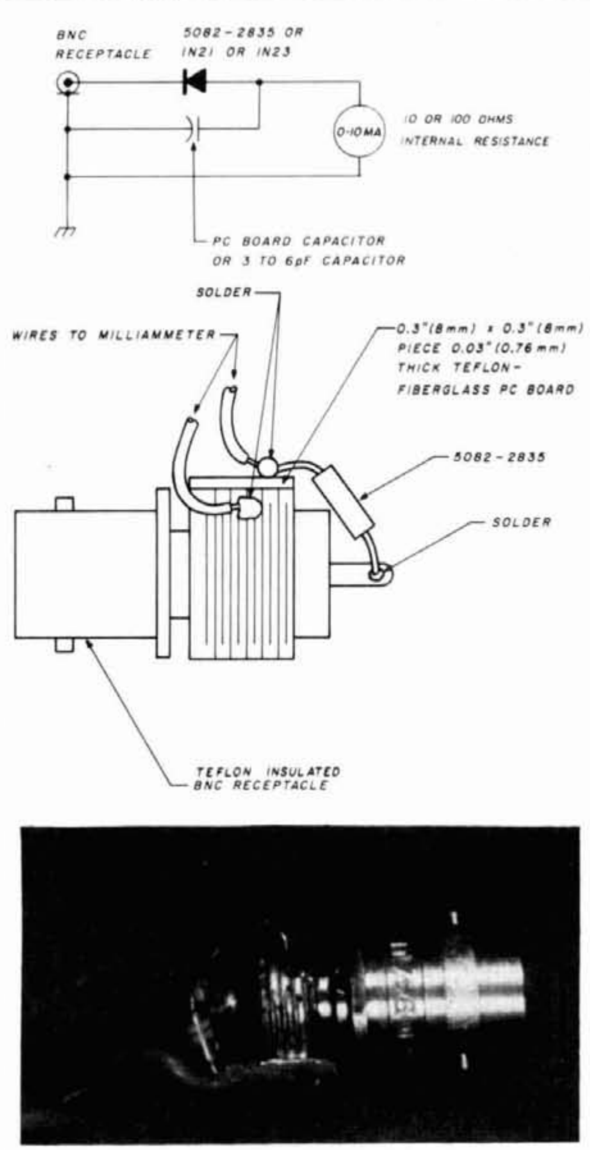


fig. 11. The diode detector is built on a teflon insulated BNC receptacle using a microwave diode and homemade bypass capacitor.

outer tube marked again. Some shift in frequency of the VCO (10 or 20 MHz) occurs as the line stretcher is lengthened, but the frequency is approximately the same at each minimum. The distance (*d*) in cm between these two marks is equal to the wavelength divided by 2. The frequency (*f* in MHz) is equal to 15,000 divided by *d*. With careful adjustment and measurement, it should be possible to tune the oscillator to the center of the upper 13-cm band (12.4 cm). Since the total tuning range of this VCO is about 1.8 to 2.6 GHz, voltages between about −4 and −6 volts should tune the entire 13-cm band.

Frequency can be determined more accurately by injecting a known frequency (or harmonic of a known

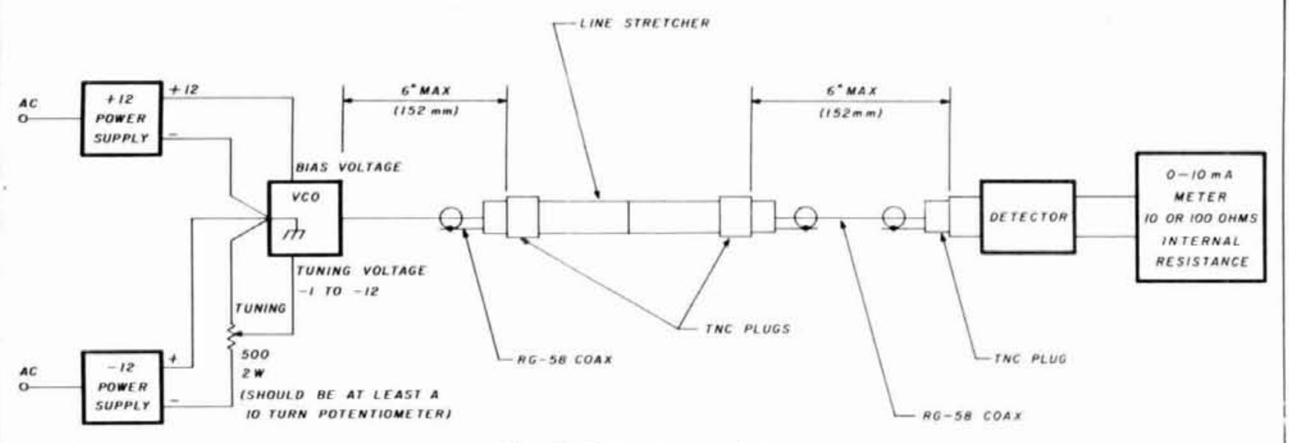


fig. 12. Test configuration.

frequency) into the detector area with a probe and tuning the VCO until a zero beat indication is displayed on an oscilloscope. Frequency modulation of the VCO or frequency standard will cause a "birdie" to appear on the oscilloscope if the horizontal sweep of the oscilloscope is synchronized with the modulation frequency. This makes it easier to find the VCO frequency since tuning is very rapid through the 2 or 3 MHz bandwidth of the oscilloscope.

To determine approximate power output, adjust the line stretcher for maximum current through the detector. An approximate level of output power can be determined by using **table 1**. (For more information on estimation of power output see reference 1.)

The line stretcher used above can be used to help match the output of this VCO to any load that might be used. Although this matching is not as good as can be realized with a double stub tuner, it may be adequate in many cases.[2] Matching can be improved — or made worse — by adjusting the position of the coupling loop in relation to the "hairpin" and/or adjusting the size of the coupling loop. The length or position of the "hairpin" on the solder pads may be adjusted to increase the output over a particular band of frequencies. Maximum output occurs with a tuning voltage between about −1 and −7 volts. Bias voltage can also be adjusted to change frequency and output power.

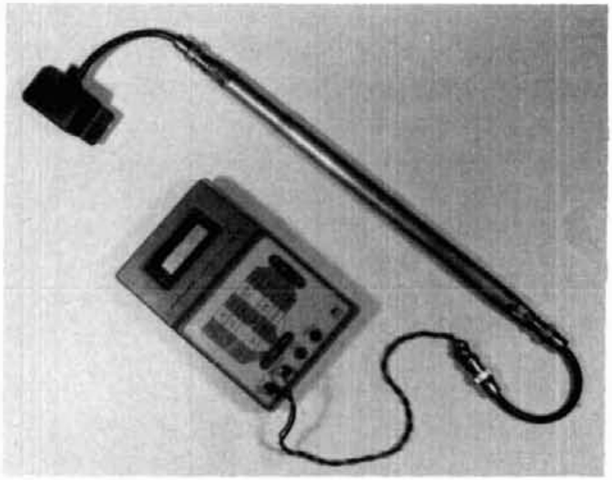


table 1. Correlation of VCO output power with current meter reading.

meter reading with Schottky diode (such as 5082-2835) (mA)	meter reading with contact diode (such as 1N21 or 1N23) (mA)	approximate power out (mW)
10-20	9-10	10-20
6-10	4-6	5-10
0.5-0.8	0.8-0.9	1

safety

There is little danger from the output of this microwave VCO since maximum power output is about 15 mW. (OSHA sets 10 mW/cm² as the maximum safe radiation density.) If the maximum 15 mW output of this VCO were concentrated in an area of less than 1.5 cm² there could be a hazard. This might happen with a waveguide horn, parabolic antenna, or other type of high gain device. When working with microwaves never look into an active waveguide, antenna, or other high gain device. Never place your head at the focal point of an irradiated high gain antenna. Microwave radiation above 10 mW/cm² can harm your eyes. *Never expose your body to high-level radiation*.

applications

This VCO has many uses. It can be used as a local oscillator, as a low-power FM transmitter or exciter, as a component in a spectrum analyzer or sweep generator, as a signal source to test amplifiers, attenuators, antennas, transistors, filters, oscillators, detectors, feed horns, or mixers. It can also be used at slightly lower frequencies for TVRO reception if a doubling mixer is used.[3]

This VCO cannot, however, be used with narrowband systems where crystal stability and minimum phase noise are required. If accurate frequency control is needed, a phase-locked loop and frequency counter may be added to the VCO.[4]

If you have problems with the construction, testing, or operation of this VCO I'll be glad to help you. Please send a SASE with your inquiry to me at the address shown at the beginning of this article.

references

1. Evans & Jessop, *VHF-UHF Manual*, (RSGB), 1982, page 8.16.
2. George Hatherell, "Double-stub Tuner for 1296 MHz," *ham radio*, December, 1978, page 72.
3. Jim Dietrich, "Twin-diode Mixer — A New Microwave Mixer," *ham radio*, October, 1978, page 84.
4. Norman J. Foot, "Multipurpose Voltage-tuned UHF Oscillator," *ham radio*, December, 1980, page 12.

ham radio

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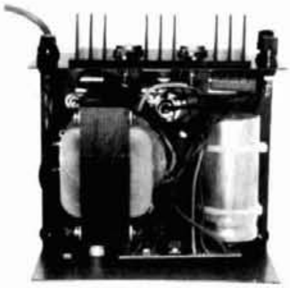

INSIDE VIEW — RS-12A

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• HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •

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SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
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- RIPPLE: Less than 5mv peak to peak (full load & low line)

MODEL RS-50A

MODEL RS-50M

MODEL VS-50M

RM-A Series

MODEL RM-35A

19" X 5¼ RACK MOUNT POWER SUPPLIES

Model	Continuous Duty (AMPS)	ICS* (AMPS)	Size (IN) HXWXD	Shipping Wt. (lbs.)
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50

RS-A SERIES

MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-4A	3	4	3¾ x 6½ x 9	5
RS-7A	5	7	3¾ x 6½ x 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 x 7½ x 10¾	11
RS-12A	9	12	4½ x 8 x 9	13
RS-20A	16	20	5 x 9 x 10½	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13¾ x 11	46

RS-M SERIES

MODEL RS-35M

- Switchable volt and Amp meter

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt (lbs)
RS-12M	9	12	4½ x 8 x 9	13
RS-20M	16	20	5 x 9 x 10½	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13¾ x 11	46

VS-M SERIES

MODEL VS-20M

- Seperate Volt and Amp Meters
- Output Voltage adjustable from 2-15 volts
- Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H x W x D	Shipping Wt (lbs)
VS-20M	16	9	4	20	5 x 9 x 10½	20
VS-35M	25	15	7	35	5 x 11 x 11	29
VS-50M	37	22	10	50	6 x 13¾ x 11	46

RS-S SERIES

MODEL RS-12S

- Built in speaker

MODEL	Continous Duty (Amps)	ICS* Amps	Size (IN) H x W x D	Shipping Wt (lbs)
RS-7S	5	7	4 x 7½ x 10¾	10
RS-10S	7.5	10	4 x 7½ x 10¾	12
RS-10L(For LTR)	7.5	10	4 × 9 × 13	13
RS-12S	9	12	4½ x 8 x 9	13
RS-20S	16	20	5 x 9 x 10½	18

More Details? CHECK—OFF Page 126

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trade off power
for antenna gain at VHF?

These computer programs simplify calculations and help you decide

If you operate at VHF or UHF frequencies and would like to find the most cost-effective way to increase your range — or if you have $100 to spend but don't know whether to invest it in higher power, more antenna gain, or a taller tower — a few minutes at your computer can give you projected communications ranges for any combination you wish to try. While programs shown in **fig. 1** and **2** are written for Commodore-64 and Texas Instruments-99/4A computers, respectively, they can be easily converted, using BASIC, for use on other microcomputers. Both free space range (for satellite communications) and range over real earth are given.

propagation curves

Although propagation curves have been available for about 40 years, most hams have either not been aware of them or have not known how to use them. The classical curves developed by Bell Labs cover frequencies from 200 kHz to 600 MHz, distances of 0.5 to 1000 miles, and are arranged in six sections covering propagation over sea water, good soil, and poor soil for vertical and horizontal polarizations.[1] Typical inputs and outputs are expressed in terms of 1 kW transmitted from a grounded vertical antenna and units of field strength in dB above 1 microvolt per meter, however, and one must be wise in the ways of antenna conversions to use them. Predictions are also complicated at HF, where antennas are usually located within a few wavelengths of ground, because actual antenna directivity and efficiency are directly affected by soil conductivity.

Propagation predictions at VHF and UHF are more straightforward because antennas at these frequencies are usually mounted many wavelengths above ground. At these frequencies the communications range is essentially independent of polarization used and soil type for antenna heights of 100 feet or more, and variations of not more than 3 or 4 dB are to be expected at heights of 25 feet. Based upon these facts (and other assumptions), the ESSA curves are useful for frequencies above 100 MHz.[2]

The computer programs described below utilize data taken from selected curves in reference 2. After you enter operating frequency, receiver sensitivity, transmitter power, and antenna heights and gains, the programs calculate your expected communications range. A typical output from the Commodore-64 program is shown in **fig. 1A**.

C-64 program description

This section describes the program as written for the Commodore-64 because the machine is very popular among hams and because the program contains the most features. (Similar versions for other computers, with fewer features, will be described later.) In the Commodore-64 program shown in **fig. 1, line**

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fig. 1. Communications range calculation program for the Commodore 64.

```
2 GOSUB 500
10 PRINTCL$:PRINT"          VHF/UHF PROPAGATION PROGRAM
12 PRINT:PRINT"             FOR THE COMMODORE 64
14 PRINT:PRINT"                 V1.0 C 1984 BY
16 PRINT:PRINT"                 LYNN A. GERIG
20 FORJ=1TO10:PRINT:NEXT
22 PRINT"TO CHANGE BORDER, SCREEN, OR LETTER
24 PRINT"COLORS, PRESS B, S, OR L, RESPECTIVELY.
26 PRINT:PRINT"TO EXIT TO PROGRAM, PRESS <RETURN>.
30 GETA$:IFA$=""THEN30
32 IFA$="B"THENPOKE53280,(PEEK(53280)AND15)+1
34 IFA$="S"THENPOKE53281,(PEEK(53281)AND15)+1
36 IFA$="L"THENPOKE646,(PEEK(646)AND15)+1:GOTO10
38 IFA$=CHR$(13)THEN50
40 GOTO30
50 PRINTCL$"THIS PROGRAM WILL CALCULATE EXPECTED
52 PRINT"RANGES FOR VHF (100-175 MHZ) AND UHF
54 PRINT"(225-500 MHZ) FREQUENCIES.  APPROXIMATE
56 PRINT"DYNAMIC RANGE IS FOR PATH LOSSES OF 125
58 PRINT"TO 200 DB, COVERING MOST APPLICATIONS
60 PRINT"FOR RCVR SENS .5 TO 10 MICRO-VOLTS AND
62 PRINT"XMTR POWER OF 1 TO 1000 WATTS.  PROGRAM
64 PRINT"COVERS ANTENNA HEIGHTS FROM 25 FT TO    100,000 FT.
70 PRINT:PRINT"PROGRAM DEFAULTS TO RCVR SENS AND XMTR
72 PRINT"PWR IN DBM.  WOULD YOU RATHER WORK WITH
74 PRINT"MICRO-VOLTS AND WATTS (Y=YES)";:INPUT D$
100 PRINTCL$"PRESS <V> FOR VHF OR <U> FOR UHF":PRINT
102 GETF$
104 IFF$="V"THENPRINT"ENTERING VHF DATA":GOSUB2000:GOTO200
106 IFF$="U"THENPRINT"ENTERING UHF DATA":GOSUB3000:GOTO200
108 GOTO102
199 :
200 PRINT:GOSUB600:REM SELECT FREQUENCY
205 PRINT:GOSUB700:REM SELECT XMTR PWR & RCVR SENS
210 PRINT:GOSUB900:REM SELECT ANTENNA GAINS
215 PRINT:GOSUB800:REM SELECT ANTENNA HEIGHTS
220 :
300 PRINTCL$F$"HF PROPAGATION:  FREQ ="F"MHZ
302 PRINT:PRINT"TRANSMITTER POWER OUT:"PD;TAB(30);"DBM
304 PRINTTAB(22)PW;TAB(30)"WATTS"
306 PRINT:PRINT"RECEIVER SENSITIVITY: "RD;TAB(30)"DBM
308 PRINTTAB(22)RM;TAB(30)"UV
310 PRINT:PRINT"LOWER ANTENNA : "GL"DBI @"H1"FT
312 PRINT"UPPER ANTENNA : "GU"DBI @"H2"FT
314 PRINT:PRINT"COAXIAL LINE LOSSES : "LL"DB
320 PL=PD-RD+GU+GL-LL
322 DF=PL-37-20*LOG(F)/LOG(10)
324 DF=10^(DF/20):DF=INT(DF+.5)
326 PRINT:PRINTPL"DB PATH
328 PRINT"FREE SPACE PATH ="DF"MILES
350 PL=PL-20*LOG(F/F1)/LOG(10):PRINT
352 IFPL<P1THENPRINT"RANGE NOT IN PROGRAM:  <"S1"MILES
354 IFPL<P1THENPRINTTAB(23)"<"D1"(NAUT MI)":GOTO400
356 IFPL>P5THENPRINT"RANGE NOT IN PROGRAM:  >"S5"MILES
358 IFPL>P5THENPRINTTAB(23)">"D5"(NAUT MI)":GOTO400
360 IFPL>=P1ANDPL<P2THEN DN=D1+(D2-D1)*(PL-P1)/(P2-P1)
362 IFPL>=P2ANDPL<P3THEN DN=D2+(D3-D2)*(PL-P2)/(P3-P2)
364 IFPL>=P3ANDPL<P4THEN DN=D3+(D4-D3)*(PL-P3)/(P4-P3)
366 IFPL>=P4ANDPL<P5THEN DN=D4+(D5-D4)*(PL-P4)/(P5-P4)
368 DS=INT(DN*1.151+.5):DN=INT(DN+.5)
370 PRINT"MAXIMUM EXPECTED RANGE: "DS"MILES
372 PRINTTAB(24)DN"(NAUT MI)
400 PRINT:PRINT:PRINTLL$
402 PRINT"G=MODIFY ANT GAINS        R=RUN AGAIN
404 PRINT"H=MODIFY ANT HEIGHTS      P=PRINTER DUMP
406 PRINT"X=MODIFY R/T SENS/PWR     Q=QUIT
408 PRINT"F=NEW FREQ (SAME BAND)";
410 FORJ=1TO10:GETA$:NEXT
412 GETA$:IFA$=""THEN412
413 IFA$="P"THEN430
414 PRINT:PRINT
415 IFA$="R"THEN100
416 IFA$="Q"THENSYS65126
418 IFA$="G"THENGOSUB900:GOTO300
420 IFA$="H"THENGOSUB800:GOTO300
422 IFA$="X"THENGOSUB700:GOTO300
424 IFA$="F"THENGOSUB600:GOTO300
426 GOTO412
430 REM SCREEN DUMP TO PRINTER
432 OPEN3,3:OPEN4,4:PRINTHO$;:PRINT#4:PRINT#4,LL$
434 FORJ=0TO759:GET#3,A$:PRINT#4,A$;:NEXT:PRINT#4,LL$
436 CLOSE4:CLOSE3:FORJ=1TO5:PRINT:NEXT:GOTO412
500 HO$=CHR$(19):CL$=CHR$(147):D$="N":DIMH$(15,15):DIMH(15)
502 H(1)=25:H(2)=50:H(3)=100:H(4)=500:H(5)=1000:H(6)=2000
504 H(7)=5000:H(8)=10000:H(9)=15000:H(10)=20000:H(11)=30000
506 H(12)=40000:H(13)=60000:H(14)=80000:H(15)=100000
508 LL$=" ---------------------------------------"
510 RETURN
600 PRINT"FREQUENCY IN MHZ ("FL"-"FU")";:INPUTF
602 IFF<FLORF>FUTHEN600
604 RETURN
700 IFD$="Y"THENINPUT"INPUT XMTR POWER (IN WATTS)";PW:GOTO710
702 INPUT"INPUT XMTR POWER (IN DBM)";PD
704 PW=(PD-30)/10:PW=10^PW
706 IFPW>=1THENPW=INT(PW*10+.5)/10:GOTO720
708 IFPW<1THENPW=INT(PW*1000+.5)/1000:GOTO 720
710 PD=10*LOG(PW)/LOG(10)+30:PD=INT(PD*10+.5)/10
720 IFD$="Y"THENINPUT"RCVR SENSITIVITY (IN MICRO-VOLTS)";RM:GOTO730
722 INPUT"RCVR SENSITIVITY (IN DBM)";RD
723 IFRD>0THENPRINT"<1 MW IS A NEGATIVE NUMBER":GOTO722
724 RM=(RD+107)/20:RM=10^RM
726 IFRM>=1THEN RM=INT(RM*10+.5)/10:GOTO740
728 IFRM<1THEN RM=INT(RM*100+.5)/100:GOTO740
730 RD=20*LOG(RM)/LOG(10)-107:RD=INT(RD*10+.5)/10
740 RETURN
800 REM ANTENNA HEIGHTS
802 PRINTCL$"CHOOSE ANTENNA HEIGHTS BY SELECTING
804 PRINT"NUMBERS FROM THE FOLLOWING MENU":PRINT:PRINT
806 PRINT"1 =    25'     6 =    2000'    11 =   30000'
808 PRINT"2 =    50'     7 =    5000'    12 =   40000'
810 PRINT"3 =   100'     8 =   10000'    13 =   60000'
812 PRINT"4 =   500'     9 =   15000'    14 =   80000'
814 PRINT"5 =  1000'    10 =   20000'    15 =  100000'
820 PRINT:PRINT
830 INPUT"SELECT HEIGHT OF LOWER ANTENNA";H1
832 INPUT"SELECT HEIGHT OF UPPER ANTENNA";H2
834 IFH1<1ORH2<1ORH1>15ORH2>15THENPRINT"NOT IN MENU":GOTO830
836 IFH1>H2THENPRINT"LOWER AND UPPER REVERSED":GOTO830
840 H$=H$(H1,H2):H1=H(H1):H2=H(H2)
850 P1=VAL(MID$(H$,1,3)):D1=VAL(MID$(H$,4,3))
852 P2=VAL(MID$(H$,7,3)):D2=VAL(MID$(H$,10,3))
854 P3=VAL(MID$(H$,13,3)):D3=VAL(MID$(H$,16,3))
856 P4=VAL(MID$(H$,19,3)):D4=VAL(MID$(H$,22,3))
858 P5=VAL(MID$(H$,25,3)):D5=VAL(MID$(H$,28,3))
860 S1=INT(D1*1.151+.5)
862 S5=INT(D5*1.151+.5)
870 PRINTCL$:RETURN
900 INPUT"GAIN OF LOWER ANTENNA (IN DBI)";GL
902 INPUT"GAIN OF UPPER ANTENNA (IN DBI)";GU
904 INPUT"COAXIAL LINE LOSSES (IN DB)";LL
906 RETURN
2000 F1=125:FL=100:FU=175:REM VHF DATA
2005 H$( 1, 1)="140010160025170035176050225340
2010 H$( 1, 2)="135010160030170046175065225360
2015 H$( 1, 3)="130010160037170055175075225386
2020 H$( 1, 4)="117010162060170075175100225405
2025 H$( 1, 5)="113010165070169085173100225415
2030 H$( 1, 6)="105010158080170100175120225425
2035 H$( 1, 7)="100010140085170130177160218400
2040 H$( 1, 8)="118060132100170165176180213400
2045 H$( 1, 9)="125100150160175195185260210400
2050 H$( 1,10)="126120145170165200178215215450
2055 H$( 1,11)="130160150210177250184320210440
2060 H$( 1,12)="128180150240177285188360210470
2065 H$( 1,13)="128220145280178330188400210510
2070 H$( 1,14)="132270150330177365189440210580
2075 H$( 1,15)="132300150365178410189480210580
2080 H$( 2, 2)="125010155030165045170060210300
2085 H$( 2, 3)="120010150032165050175108210310
2090 H$( 2, 4)="110010158060167080183180208300
2095 H$( 2, 5)="105010160075168100180170207320
2100 H$( 2, 6)="110030163090170120183200208340
2105 H$( 2, 7)="115080133085162125168140210370
2110 H$( 2, 8)="120090148140165160170175210400
2115 H$( 2, 9)="125120150165170195180260210420
2120 H$( 2,10)="125140140170171215185300210440
2125 H$( 2,11)="130180145215171250182320205440
2130 H$( 2,12)="130210150250173285185360211500
2135 H$( 2,13)="130255150300174335187420206510
2140 H$( 2,14)="130290150340173370190470208560
2145 H$( 2,15)="135340150375174410185480208600
2150 H$( 3, 3)="125015155045166065174120203280
2155 H$( 3, 4)="115020152060163080177160203300
2160 H$( 3, 5)="110020152070165100195260210355
2165 H$( 3, 6)="110030150080164110195275209360
2170 H$( 3, 7)="115060140100164135196300211400
2175 H$( 3, 8)="125110158160167175184270204380
2180 H$( 3, 9)="125130140160165195172220205410
2185 H$( 3,10)="125150135170165215172240205430
2190 H$( 3,11)="125185145220165250173280210500
2195 H$( 3,12)="130220138240165280175320203480
2200 H$( 3,13)="130270145300160320170340203520
2205 H$( 3,14)="135320165370175400180440203560
2210 H$( 3,15)="135355163400175435178460204600
2215 H$( 4, 4)="110030150080159095165120204330
2220 H$( 4, 5)="115045151090160110170155204340
2225 H$( 4, 6)="116060155110161125176200204350
2230 H$( 4, 7)="123100156145165165190295210420
2235 H$( 4, 8)="125135157180165200195350210450
2240 H$( 4, 9)="130170160210168235199400218500
2245 H$( 4,10)="130190158225168260195400210495
2250 H$( 4,11)="130225160260170295184375205485
2255 H$( 4,12)="135260160294169220183400203500
2260 H$( 4,13)="125180129300163350172380202540
2265 H$( 4,14)="125180130340162385173420205600
2270 H$( 4,15)="125180132380165430174460204620
2275 H$( 5, 5)="116065144090155110165140203340
2280 H$( 5, 6)="120080145110160135170180204360
2285 H$( 5, 7)="125120145140158160165180203380
2290 H$( 5, 8)="125150150180162200167215202400
2295 H$( 5, 9)="125174150205160220165234201420
2300 H$( 5,10)="127200150225159240166260200435
2305 H$( 5,11)="129235155265160275165286202480
2310 H$( 5,12)="125180128266160305167325201500
2315 H$( 5,13)="125180130315157250168374200540
2320 H$( 5,14)="128260131355150380168410203600
2325 H$( 5,15)="128260132395160430170455199600
2330 H$( 6, 6)="125100150130160150168180200350
2335 H$( 6, 7)="122130149160160180170220200375
2340 H$( 6, 8)="125166154200160210168240200405
2345 H$( 6, 9)="125190150220160235168265200430
2350 H$( 6,10)="126212150240160260167275200445
2355 H$( 6,11)="129250153280163300170325200480
2360 H$( 6,12)="125180129285150306166335200510
2365 H$( 6,13)="125180130330155360168390205590
2370 H$( 6,14)="127220131370155405169430205620
2375 H$( 6,15)="127220132410155440168465200625
2380 H$( 7, 7)="125165150195160210169240200400
2385 H$( 7, 8)="125200143220157240166260200430
2390 H$( 7, 9)="127225155260164280170300200460
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2395 H$( 7,10)="128250153280164300170320201480
2400 H$( 7,11)="130285150310160325166340200510
2405 H$( 7,12)="125180129315150340167370200535
2410 H$( 7,13)="127230130365156395170425200580
2415 H$( 7,14)="127230132405158440170465200620
2420 H$( 7,15)="127230133445155470170500200650
2425 H$( 8, 8)="129235155265163280168300200460
2430 H$( 8, 9)="130260155290160300168320203500
2435 H$( 8,10)="130280155310164330169350200505
2440 H$( 8,11)="130320150340162360170385200540
2445 H$( 8,12)="125180131350157380170410200565
2450 H$( 8,13)="125180132395160435170460200605
2455 H$( 8,14)="127230133440156470170500200650
2460 H$( 8,15)="127230133475160510175555205720
2465 H$( 9, 9)="130290145305157320166340200505
2470 H$( 9,10)="130305155340165360170375205560
2475 H$( 9,11)="130345156375167400175430205595
2480 H$( 9,12)="125180131374155405170440200590
2485 H$( 9,13)="127240132425159460170485201640
2490 H$( 9,14)="130320133465160505170525200675
2495 H$( 9,15)="130320133500160540175580200710
2500 H$(10,10)="125180130330165380175415202560
2505 H$(10,11)="125180132370155395170430205615
2510 H$(10,12)="127230132395160435175475205640
2515 H$(10,13)="129280133450155475172510201660
2520 H$(10,14)="130300133490155515172550205725
2525 H$(10,15)="130300134525165570178620205760
2530 H$(11,11)="125180133400160440175480205650
2535 H$(11,12)="130300133435155460172500205675
2540 H$(11,13)="130300134485165530180580205725
2545 H$(11,14)="130300135525160560175600205760
2550 H$(11,15)="130300135560165605180655205800
2555 H$(12,12)="130300133460163505175540205700
2560 H$(12,13)="130300134515167560177600205750
2565 H$(12,14)="130300135555165600178640210820
2570 H$(12,15)="130300135590160625175660205825
2575 H$(13,13)="130300135540162600175635200760
2580 H$(13,14)="130300135605160635175675200805
2585 H$(13,15)="130300136640161675177715200840
2590 H$(14,14)="130300136645170700185760208900
2595 H$(14,15)="130300137685162720177760210940
2600 H$(15,15)="130300137720163760179800210980
2610 RETURN
3000 F1=300:FL=225:FU=500:REM UHF DATA
3005 H$( 1, 1)="142010170030178050182100225315
3010 H$( 1, 2)="136010150020170035178060220300
3015 H$( 1, 3)="130010150025170045176060215275
3020 H$( 1, 4)="125020168065176070188125210260
3025 H$( 1, 5)="120020165065175080185135210270
3030 H$( 1, 6)="127040145060170085177100215305
3035 H$( 1, 7)="127060140080174120178130210305
3040 H$( 1, 8)="126085140110176155180166200280
3045 H$( 1, 9)="132120145145175180181190200300
3050 H$( 1,10)="135145150170175195180210215400
3055 H$( 1,11)="135175145200177235181245200355
3060 H$( 1,12)="140220150235175265183280200380
3065 H$( 1,13)="140260150285180320185330200430
3070 H$( 1,14)="140300150325179360185370200465
3075 H$( 1,15)="140333151360180395187410200500
3080 H$( 2, 2)="132010155030166040175060215280
3085 H$( 2, 3)="125010150030164045175070213280
3090 H$( 2, 4)="120020165060170070175090210270
3095 H$( 2, 5)="120030165070171080175096210280
3100 H$( 2, 6)="120040137060167090173100210290
3105 H$( 2, 7)="125070140090170125176135210320
3110 H$( 2, 8)="131110140125170155178175205320
3115 H$( 2, 9)="135135151160170180177190205340
3120 H$( 2,10)="135160150180170205179220205360
3125 H$( 2,11)="140200145210173240180255205400
3130 H$( 2,12)="140230147240172270180285205425
3135 H$( 2,13)="140275148290173320181335200445
3140 H$( 2,14)="137308148330175365184380200480
3145 H$( 2,15)="139350150370175395184420197500
3150 H$( 3, 3)="120010140025160045170060205240
3155 H$( 3, 4)="118020160060170075183140210280
3160 H$( 3, 5)="120030160070167080173100205260
3165 H$( 3, 6)="122050155080168100175120210300
3170 H$( 3, 7)="130080155110170130175145210325
3175 H$( 3, 8)="135120168160173170177180210360
3180 H$( 3, 9)="132140166180175195180220210380
3185 H$( 3,10)="132160145180165200177220210400
3190 H$( 3,11)="135200150220170245177255215460
3195 H$( 3,12)="135230150250173280180300210460
3200 H$( 3,13)="138280150300172320180345210500
3205 H$( 3,14)="139320150340170360180380210540
3210 H$( 3,15)="140355155380172400180415210580
3215 H$( 4, 4)="120040155070165085175115205265
3220 H$( 4, 5)="125055153080167100175125210305
3225 H$( 4, 6)="125072157100170120180160210315
3230 H$( 4, 7)="128105160135170150178180210345
3235 H$( 4, 8)="132145155165168180177200215400
3240 H$( 4, 9)="135170158190172210180240210395
3245 H$( 4,10)="135192165215175240180260210420
3250 H$( 4,11)="135225165255175275180290210450
3255 H$( 4,12)="138260160280172295180320215500
3260 H$( 4,13)="140310155325170340180365210520
3265 H$( 4,14)="140352160370171385180206210560
3270 H$( 4,15)="140390154400170420180240210590
3275 H$( 5, 5)="124065160100171120177140210310
3280 H$( 5, 6)="127085160115170130178160206300
3285 H$( 5, 7)="130115160144170160177180210350
3290 H$( 5, 8)="132150155170168190176206210380
3295 H$( 5, 9)="133175159200170215175230210400
3300 H$( 5,10)="135200158220170235178260210425
3305 H$( 5,11)="135232161260173280179300210455
3310 H$( 5,12)="136265160290171305180330210485
3315 H$( 5,13)="139320160340174360180380210530
3320 H$( 5,14)="140360160380174400180415210560
3325 H$( 5,15)="140394165420175436182455210600
3330 H$( 6, 6)="128105149120166140176166210340
3335 H$( 6, 7)="132135159160170175177195210360
3340 H$( 6, 8)="134170156190171210178230211400
3345 H$( 6, 9)="134195161220170232177250211420
3350 H$( 6,10)="136220160240171255179280211440
3355 H$( 6,11)="138254165280173295179315210470
3360 H$( 6,12)="137285155300170315178340211500
3365 H$( 6,13)="138330165360174375181395210540
3370 H$( 6,14)="140375164400175415181430210580
3375 H$( 6,15)="143415167440176455184480210610
3380 H$( 7, 7)="132165165200175220180240205363
3385 H$( 7, 8)="135205156220170240180270210420
3390 H$( 7, 9)="136230160250170265180295210445
3395 H$( 7,10)="130130135245165275176300210460
3400 H$( 7,11)="131140137188168315178335210495
3405 H$( 7,12)="133200138315165345180375210525
3410 H$( 7,13)="133200139368170400182430212580
3415 H$( 7,14)="135240140410170440180465210610
3420 H$( 7,15)="135240140445165470180495210640
3425 H$( 8, 8)="130140135235165260180300210450
3430 H$( 8, 9)="130140136255165290177310210470
3435 H$( 8,10)="130140137280165310178340205470
3440 H$( 8,11)="130140138320165346178370210520
3445 H$( 8,12)="135240138350168380179405210550
3450 H$( 8,13)="135240139400170430180455210600
3455 H$( 8,14)="135240140445170470180495210640
3460 H$( 8,15)="137300141480170510182540210670
3465 H$( 9, 9)="132160137286169320183360210500
3470 H$( 9,10)="132160138310169340183380210515
3475 H$( 9,11)="135240138347170380180405210550
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3490 H$( 9,14)="135240141465170500181525210660
3495 H$( 9,15)="138340142505165530181560210695
3500 H$(10,10)="135240138330167360180390210530
3505 H$(10,11)="135240138370168400180425208560
3510 H$(10,12)="135240139395170430182460210595
3515 H$(10,13)="135240140446170480185520210640
3520 H$(10,14)="137300141490170520180545210680
3525 H$(10,15)="137300142525170585185595210715
3530 H$(11,11)="135240140405165430180455210600
3535 H$(11,12)="135240140430165460181490210630
3540 H$(11,13)="137300141505172520183550210670
3545 H$(11,14)="137300142528172560185590210715
3550 H$(11,15)="138300143565170592186630210750
3555 H$(12,12)="140400141445175505184530210660
3560 H$(12,13)="140400142515172550187590210705
3565 H$(12,14)="140400143555165580185620209740
3570 H$(12,15)="140400143590175635186670210780
3575 H$(13,13)="138360142565170595186630210755
3580 H$(13,14)="138360143608170640185670210790
3585 H$(13,15)="138360144645178690191730210830
3590 H$(14,14)="140420143647170680185710210830
3595 H$(14,15)="140420144686170715188755210870
3600 H$(15,15)="140400145720170750190800210900
3610 RETURN
```

```
VHF PROPAGATION:   FREQ = 146.5 MHZ

TRANSMITTER POWER OUT: 44.8    DBM
                       30      WATTS

RECEIVER SENSITIVITY: -110.7   DBM
                       .65     UV

LOWER ANTENNA :   12.4 DBI @ 50 FT
UPPER ANTENNA :   7.5 DBI @ 100 FT

COAXIAL LINE LOSSES :   1.6 DB

 173.8 DB PATH
FREE SPACE PATH = 47224 MILES

MAXIMUM EXPECTED RANGE:   105 MILES
                          91 (NAUT MI)

G=MODIFY ANT GAINS          R=RUN AGAIN
H=MODIFY ANT HEIGHTS        P=PRINTER DUMP
X=MODIFY R/T SENS/PWR       Q=QUIT
F=NEW FREQ (SAME BAND)
```

fig. 1A. Typical output from Commodore-64 program.

2 sends you to a subroutine (**lines 500-510**) where arrays are dimensioned and certain variables are established. The actual program begins with **line 10**.

Lines 10 through **40** display the program title on the screen and provide the opportunity to select any combination of screen, border, and letter colors — assuming, of course, that you're using a color monitor — that you find pleasing. You're not stuck with the light blue and dark blue default colors of the Commodore 64. (This option is not included in the other versions.) In **lines 50-74** you choose whether to work with receiver sensitivity and transmitter power in microvolts and watts or in dBm (decibels relative to 1 milliwatt). This is for your convenience only; the program will convert either type input to the other and display both as an output. In lines **100-108** you select either VHF or UHF as your operating band, and the appropriate data is read (VHF data lines **2000-2610** or UHF data lines **3000-3610**).

Actual program inputs for range calculations begin at **line 200** where you are sequentially sent to subroutines for selecting frequency, transmitter and receiver parameters, antenna gains, and antenna heights.

The subroutine in **lines 600-604** asks for a specific operating frequency within the band you selected. Actual VHF data is for 125 MHz, and UHF data is for 300 MHz, but the program scales to your actual operating frequency by a 20 × Log (F/F ref) factor in **line 350** to show propagation variations within a given band.

The subroutine in **lines 700-740** asks for receiver sensitivity and transmitter power output. The units are either microvolts and watts or dBm, depending on which you selected in **line 74**. Your input is converted to both units which will be displayed later.

The subroutine in **lines 900-906** asks for antenna gains in dBi. This is gain in dB relative to an isotropic antenna. If your antenna gain is known relative to a dipole, add 2.15 dB. For example, an antenna with 7.5 dB gain referenced to a dipole (dBd) has a gain of 9.65 dBi. You are next asked to enter any system losses, such as coaxial line losses.

Actual antenna heights are selected in the subroutine from **lines 800-870**. The data tables from lines 2000 to the end of the program contain propagation information for specific antenna heights, so you must choose a discrete value closest to your actual antenna height. For example, if your antenna height is 40 or 60 feet, use menu item 2, which is 50 feet. If you select antenna heights of 50 feet and 100 feet (menu items 2 and 3), the program then selects H$ (2,3) data for these heights from **line 2085** or **3085** depending on whether you are operating at VHF or UHF. The string manipulation in **lines 850-858** will be described later.

The actual program output to the screen is performed in **lines 300-426**. A sample output was shown in **fig. 1A**. The operating frequency is printed, followed by XMTR output in dBm and watts and RCVR sensitivity in dBm and μv. The antenna gains and heights selected are then printed followed by the losses selected. The next item printed is the system path margin in dB, followed by the free space path loss in miles. (This is the distance over which you could communicate if it were not for the earth's curvature, useful in determining whether or not you can reach your favorite satellite.) Finally, the range over real earth is printed in both statute and nautical miles. The range given is the expected range for normal conditions; actual range will be affected by atmospheric conditions, terrain, and other factors.

One of the features of this program is that you can experiment with changes in a single parameter without having to re-enter all previous inputs. Note the menu at the bottom of the screen (see **fig. 1A**). Would you like to see how much further you could communicate if you raised your antenna from 25 to 50 feet. Just press "H" on the keyboard and you will be asked for new antenna height (subroutine at **line 800** from **line 420**), and the new range for that height will be instantly displayed. With a few keystrokes you can easily compare expected improvements in range from changes in antenna height, antenna gain, power output, and other factors. If you have a printer, just press "P" and **lines 430-436** will give you a screen dump to it.

data format

The data in the lines following **line 2000** are taken from the ESSA Technical Report mentioned in reference 2; there are about 100 pages of curves with up to 17 curves per page in that document. The programs store selected data points from various curves, and they construct "piece-wise linear" equations fitting the original curve as nearly as possible. For the curious, the following is a detailed explanation of the data manipulations. Assume you have selected VHF and antenna heights of 50 and 100 feet. Logical breakpoints in the ESSA curves are 10 miles for a 120 dB path, 32 miles for a 150 dB path, 50 miles for a 165 dB path, 105 miles for a 175 dB path, and 310 miles for a 210 dB path. Now look at line 2085 and note that

H$(2,3) = "120010150032165050175105210310".

The first three digits (120) store the first path point; the next three digits (010) store the first distance point; the third three digits (150) store the second path point; the fourth three digits (032) store the second distance point, and so on. The last three digits (310) represent the last mileage point. After antenna heights are chosen (**lines 800-832**), the appropriate data line is divided up into five path points and five distance points by string manipulation in **lines 840-858**.

After the program calculates your system path margin (**lines 320** and **350**) from the various inputs, the program path is compared to the data points described

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above. If it is less than the smallest or greater than the largest, a "Range Not In Program" message is printed (**lines 352-358**). If the path margin falls between the data endpoints, the program calculates expected range by assuming a straight line between the nearest two points stored (**lines 360-366**), and the expected range is printed to the screen.

entering the program

Enter the program as listed, taking the normal precautions to SAVE it before you RUN it so that if you make a typing error that could cause a lock-up, you'll be able to go back to the saved version without having to retype the entire program.

As listed, the program contains data statements for altitudes to 100,000 feet (includes air-to-ground and air-to-air data for you aeronautical mobile enthusiasts.) If you plan to use the program only for ground-to-ground communications, you can omit any data statements with H$(x,y) array subscripts greater than 4. For example, for VHF data including antenna heights of 25, 50, 100, and 500 feet, you need to type only **lines 2000-2020, 2080-2090, 2150-2155, 2215,** and **2610**. Just don't try to select a height (**lines 800-832**) for which you didn't enter any data.

If you don't want to keystroke the Commodore-64 program yourself, send a blank tape or formatted disk with a stamped, self-addressed tape or disk mailer, and a check or money order for $5.00 to Lynn A. Gerig, R. R. #1, Monroeville, Indiana 46773, and two verified copies will be made for you. A similar program — ground-to-ground only, with some other features missing — that has been "crunched" to fit within the 3.5K memory of an unexpanded VIC-20 is available under the same terms. (A printed listing of any programs described is available for $1 and a self-addressed envelope with two first-class stamps attached.)

TI-99/4A program

Except for **lines 22-40**, which poke screen and letter colors to appropriate memory locations, the Commodore 64 program described above has nothing particularly unique to that machine, and can easily be converted to run on other computers using BASIC. Subtle differences between machines, however, make certain conversions necessary. For example, although the Commodore clears the screen with a "PRINT CHR$(147)", some other brands use "CALL CLEAR" or some other command. In addition, some computers will not permit the use of multiple statements on a single BASIC line number.

A program for the TI-99/4A is listed in **fig. 2**. Because this computer has only 16K of memory, and the complete program requires about 20K of RAM, separate VHF and UHF programs are required, and not

fig. 2. Communications range calculation program for the TI-99/4A.

```
10 GOSUB 222
12 CALL CLEAR
14 PRINT TAB(3);"VHF PROPAGATION PROGRAM"
16 PRINT
18 PRINT TAB(7);"FOR THE TI-99/4A"
20 PRINT
22 PRINT TAB(14);"BY"
24 PRINT
26 PRINT TAB(9);"J.R. HENNEL"
28 FOR DELAY=1 TO 1000
30 NEXT DELAY
32 GOTO 34
34 CALL CLEAR
36 PRINT "THIS PROGRAM WILL CALCULATE"
38 PRINT "EXPECTED RANGES FOR VHF(100"
40 PRINT "-175 MHZ) FREQUENCIES.  AP-"
42 PRINT "PROXIMATE DYNAMIC RANGE IS"
44 PRINT "FOR PATH LOSSES OF 125 TO"
46 PRINT "200 DB, COVERING MOST AP-"
48 PRINT "PLICATIONS FOR RCVR SENSI-"
50 PRINT "TIVITIES FROM .5 TO 10 MIC-"
52 PRINT "ROVOLT AND XMTR PWR OF 1 TO"
54 PRINT "1000 WATTS.  THE PROGRAM "
56 PRINT "COVERS ANTENNA HEIGHTS FROM"
58 PRINT "25 FT TO 40,000 FT. PROGRAM"
60 PRINT "DEFAULTS TO RCVR SENS AND"
62 PRINT "XMTR PWR IN DBM. WOULD YOU"
64 PRINT "RATHER WORK WITH MICROVOLTS"
66 PRINT "AND WATTS? (Y=YES)"
68 INPUT D$
70 GOSUB 2005
72 GOSUB 258
74 GOTO 76
76 PRINT
78 GOSUB 266
80 PRINT
82 GOSUB 408
84 PRINT
86 GOSUB 328
88 PRINT
90 CALL CLEAR
92 PRINT " VHF PROPAGATION:"
94 PRINT TAB(3);" FREQUENCY   ";F;TAB(24);"MHZ"
96 PRINT " TRANSMITTER POWER OUT:"
98 PRINT TAB(3);"=";PD;TAB(10);"DBM =";PW;TAB(24);"WATTS"
100 PRINT " RECEIVER SENSITIVITY:"
102 PRINT TAB(3);"=";RD;TAB(10);"DBM =";RM;TAB(24);"UV"
104 PRINT " LOWER ANTENNA:"
106 PRINT TAB(3);"=";GL;TAB(10);"DBI @ ";H1;TAB(24);"FT"
108 PRINT " UPPER ANTENNA:"
110 PRINT TAB(3);"=";GU;TAB(10);"DBI @ ";H2;TAB(24);"FT"
112 PRINT " COAXIAL LINE LOSSES:"
114 PRINT TAB(3);"=";LL;TAB(10);"DB"
116 PL=PD-RD+GU+GL-LL
118 DF=PL-37-20*LOG(F)/LOG(10)
120 DF=10^(DF/20)
122 DF=INT(DF+.5)
124 PRINT TAB(3);PL;"DB";TAB(14);"PATH"
126 PRINT " FREE SPACE PATH=";DF;TAB(24);"MILES"
128 PL=PL-20*LOG(F/F1)/LOG(10)
130 PRINT
132 IF PL<P1 THEN 134 ELSE 136
134 PRINT "RANGE NOT IN PROGRAM: <";S1;"MILES"
136 IF PL<P1 THEN 138 ELSE 142
138 PRINT TAB(23);"<";D1;"(NAUT MI)"
140 GOTO 176
142 IF PL>P5 THEN 144 ELSE 146
144 PRINT "RANGE NOT IN PROGRAM: >";S5;"MILES"
146 IF PL>P5 THEN 148 ELSE 152
148 PRINT TAB(23);">";D5;"(NAUT MI)"
150 GOTO 176
152 IF (PL>=P1)*(PL<P2)THEN 154 ELSE 156
154 DN=D1+(D2-D1)*(PL-P1)/(P2-P1)
156 IF (PL>=P2)*(PL<P3)THEN 158 ELSE 160
158 DN=D2+(D3-D2)*(PL-P2)/(P3-P2)
160 IF (PL>=P3)*(PL<P4)THEN 162 ELSE 164
162 DN=D3+(D4-D3)*(PL-P3)/(P4-P3)
164 IF (PL>=P4)*(PL<P5)THEN 166 ELSE 168
166 DN=D4+(D5-D4)*(PL-P4)/(P5-P4)
168 DS=INT(DN*1.151+.5)
170 DN=INT(DN+.5)
172 PRINT " MAXIMUM EXPECTED RANGE:"
174 PRINT TAB(3);"=";DS;TAB(12);"MILES =";DN;TAB(24);"N MI"
176 PRINT LL$
178 PRINT " G=MOD ANT GAIN  R=RUN AGAIN"
180 PRINT " H=MOD ANT HT    F=NEW FREQ"
182 PRINT " X=MOD R/T SENS/PWR  Q=QUIT"
184 INPUT A$
186 IF A$=" " THEN 184
188 PRINT
190 PRINT
192 IF A$="R" THEN 72 ELSE 194
194 IF A$="Q" THEN 196 ELSE 198
196 END
198 IF A$="G" THEN 200 ELSE 204
200 GOSUB 408
202 GOTO 90
204 IF A$="H" THEN 206 ELSE 210
206 GOSUB 338
208 GOTO 90
210 IF A$="X" THEN 212 ELSE 216
212 GOSUB 266
214 GOTO 90
216 IF A$="F" THEN 218
218 GOSUB 258
220 GOTO 90
222 CALL CLEAR
224 D$="N"
226 DIM H$(12,12)
228 DIM H(12)
230 H(1)=25
232 H(2)=50
234 H(3)=100
236 H(4)=500
238 H(5)=1000
240 H(6)=2000
```

```
242 H(7)=5000
244 H(8)=10000
246 H(9)=15000
248 H(10)=20000
250 H(11)=30000
252 H(12)=40000
254 LL$="-----------------------------"
256 RETURN
258 PRINT " FREQUENCY IN MHZ (100-175)"
260 INPUT "      ";F
262 IF (F<FL)+(F>FU)THEN 258
264 RETURN
266 IF D$="Y" THEN 268 ELSE 272
268 INPUT "INPUT XMTR PWR (IN WATTS)        ";PW
270 GOTO 292
272 INPUT "INPUT XMTR POWER (IN DBM):       ";PD
274 PRINT
276 PW=(PD-30)/10
278 PW=10^PW
280 IF PW>=1 THEN 282 ELSE 286
282 PW=INT(PW*10+.5)/10
284 GOTO 298
286 IF PW<1 THEN 288
288 PW=INT(PW*100+.5)/100
290 GOTO 298
292 PD=10*LOG(PW)/LOG(10)+30
294 PD=INT(PD*10+.5)/10
296 PRINT
298 IF D$="Y" THEN 300 ELSE 304
300 INPUT " RCVR SENS (IN MICROVOLTS)       ";RM
302 GOTO 322
304 INPUT "RCVR SENSITIVITY (IN DBM)       ";RD
306 RM=(RD+107)/20
308 RM=10^RM
310 IF RM>=1 THEN 312 ELSE 316
312 RM=INT(RM*10+.5)/10
314 GOTO 326
316 IF RM<1 GOTO 318
318 RM=INT(RM*100+.5)/100
320 GOTO 326
322 RD=20*LOG(RM)/LOG(10)-107
324 RD=INT(RD*10+.5)/10
326 RETURN
328 REM  ANTENNA HEIGHTS
330 CALL CLEAR
332 PRINT "CHOOSE ANTENN HEIGHTS BY"
334 PRINT "SELECTING NUMBER FROM THE"
336 PRINT "FOLLOWING MENU"
338 PRINT
340 PRINT
342 PRINT "1=  25' 5=  1000'  9= 15000'"
344 PRINT "2=  50' 6=  2000 '10= 20000'"
346 PRINT "3= 100' 7=  5000' 11= 30000'"
348 PRINT "4= 500' 8= 10000' 12= 40000'"
350 PRINT
352 PRINT
354 INPUT "SELECT HEIGHT OF LWR ANTENNA:  ";H1
356 PRINT
358 INPUT "SELECT HEIGHT OF UPR ANTENNA   ";H2
360 PRINT
362 IF (H1<1)+(H2<1)+(H1>12)+(H2>12)THEN 364 ELSE 368
364 PRINT "NOT IN MENU"
366 GOTO 354
368 IF H1>H2 THEN 370 ELSE 374
370 PRINT " LOWER AND UPPPER REVERSED"
372 GOTO 354
374 HC$=H$(H1,H2)
376 H1=H(H1)
378 H2=H(H2)
380 P1=VAL(SEG$(HC$,1,3))
382 D1=VAL(SEG$(HC$,4,3))
384 P2=VAL(SEG$(HC$,7,3))
386 D2=VAL(SEG$(HC$,10,3))
388 P3=VAL(SEG$(HC$,13,3))
390 D3=VAL(SEG$(HC$,16,3))
392 P4=VAL(SEG$(HC$,19,3))
394 D4=VAL(SEG$(HC$,22,3))
396 P5=VAL(SEG$(HC$,25,3))
398 D5=VAL(SEG$(HC$,28,3))
400 S1=INT(D1*1.151+.5)
402 S5=INT(D5*1.151+.5)
404 CALL CLEAR
406 RETURN
408 PRINT " GAIN OF LWR ANT (IN DBI):"
410 INPUT "      ";GL
412 PRINT
414 PRINT " GAIN OF UPR ANT (IN DBI):"
416 INPUT "      ";GU
418 PRINT
420 INPUT "COAXIAL LINE LOSSES (IN DB)       ";LL
422 RETURN
424 F1=125
426 FL=100
428 FU=175
430 REM  VHF DATA
```

all the altitudes used in the Commodore program will fit.

To devise a VHF program for your TI-99/4A, enter the program listed in **fig. 2**. At the end of program, type the VHF data statements (**lines 2005-2610**) listed in the Commodore version (**fig. 1**). Since the data statements are the same for all versions, they are not listed again in **fig. 2**. However, because the TI memory is too small for the complete program, only altitudes to 40,000 feet should be included. *Do not enter data lines with H$(x,y) subscripts of 13, 14, or 15. For example, do not enter* **lines 2065-2075, 2135-2145**, etc. Refer to the previous section if you want only a short ground-to-ground version.

For a UHF program for your TI, use the program listed in **fig. 2**, making the following changes:

- In **lines 14, 34**, and **430**, change "VHF" to "UHF."
- In **lines 38** and **426**, change "100" to "200."
- In **lines 40** and **428**, change "175" to "500."
- In **line 70**, change "GOSUB 2005" to "GOSUB 3005."
- In **line 258**, change "100-175" to "200-500."
- In **line 424**, change "125" to "300."

Now add the UHF data statements (**lines 3005-3610**) listed in the Commodore version (**fig. 1**), again deleting the data above 40,000 feet. Again for this program, only those data statements with H$(X,Y) subscripts of 1, 2, 3, and 4 need to be entered if you are interested in ground-to-ground calculations only.

If you don't want to type the TI programs yourself, send a blank tape — no disks — with stamped, self-addressed tape mailer, and a check or money order for $5.00 to Joe Hennel, 4316 Winston Drive, Ft. Wayne, Indiana 46806.

using the programs

The program must be used with caution. Each provides ranges over average terrain for which communications can be expected 50 percent of the time. Obviously you won't be able to communicate as far through dense jungle or through mountainous areas, so some common sense must be used. However, the programs are very useful for determining relative changes in anticipated range due to modifications to receivers, transmitters, and antennas.

When entering receiver and transmitter parameters, use power output (not input) at the transmitting end, and sensitivity at the receiving end. For example, if you are running a full kW, and your friend is running only 10 watts, he may be able to hear you without your being able to hear him.

Feel free to contact either of the authors — at their addresses given at the opening of this article — with questions or comments about the programs; only letters with an SASE enclosed will be answered.

references

1. *Propagation Curves, Report 966-6C*, National Defense Research Committee 15, Bell Telephone Laboratories, Inc., Issue 3, October, 1944 (declassified to OPEN status March 8, 1946).

2. *ESSA Technical Report ERL 111-ITS 79, Transmission Loss Atlas for Select Service Bands from 0.125 to 15.5 GHz*, Institute for Telecommunication Sciences, Boulder Colorado, May, 1969. (Available for $1.25 from Superintendent of Documents, United States Government Printing Office, Washington, D. C. 20402.)

ham radio

a 432-MHz, 1500-watt amplifier

An 8938 triode in a coaxial cavity provides maximum output power

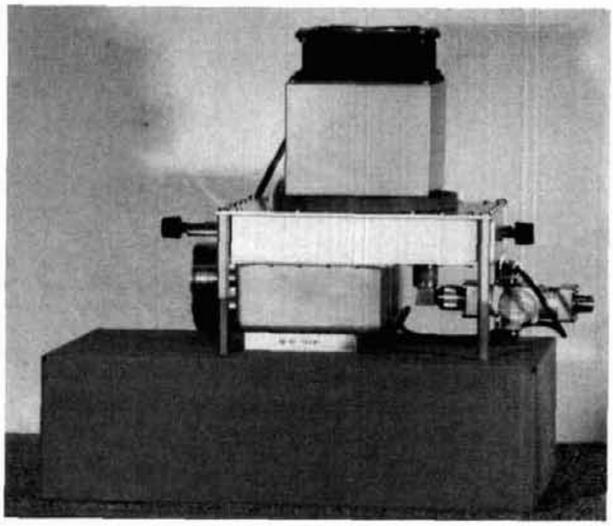

fig. 1. Front view of amplifier assembly.

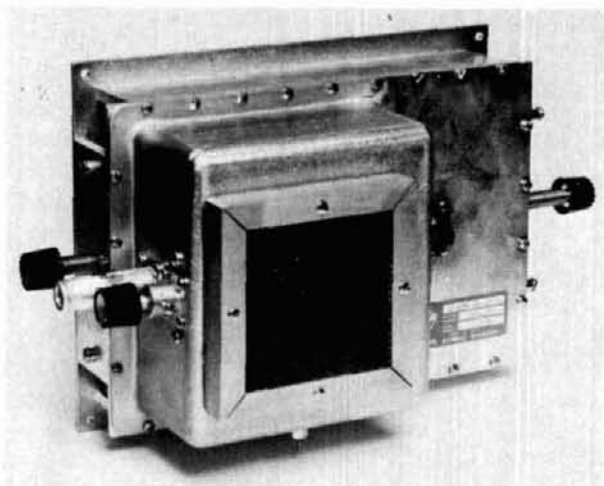

fig. 2. Cavity assembly (*photo courtesy of EIMAC Varian*).

By F. J. Merry, W2GN, P. O. Box 546, 35 Highland Drive, East Greenbush, New York 12061

This article describes an amplifier that uses an 8938 coaxial triode in a commercially available cavity assembly, and is conservatively rated for CW and SSB operation at 1500 watts output on 432 MHz. A driver capable of 100 watts output is required. With proper cavity adjustment, efficiency of over 50 percent and power gain of 12 dB are readily obtainable at high output levels. Construction is straight-forward.

The complete amplifier assembly (**fig. 1**) consists of three units: the RF section, the metering and control unit and the power supply. These units are interconnected by cables, using MHV type connectors and RG-59 cable for the high voltage and C-J (Cinch Jones) connectors with appropriate low voltage cables. The heater wires in the low voltage cables must use a conductor large enough to provide at least 4.55 volts at the cavity terminals.

This type of construction provides maximum flexibility. Each unit can be located in the most favorable position for its particular function, thereby simplifying maintenance.

RF section

The cavity assembly (**fig. 2**) is mounted on a chassis measuring 10 inches (25.4 cm) wide, 17 inches (43 cm) long and 5 inches (12.7 cm) high, supported by metal stand-offs at the four corners of the upper plate of the cavity. A square opening to match the size of the EMI filter mounted on the bottom of the cathode cavity is cut into the chassis. Holes to match the four mounting holes for the EMI filter are drilled through the

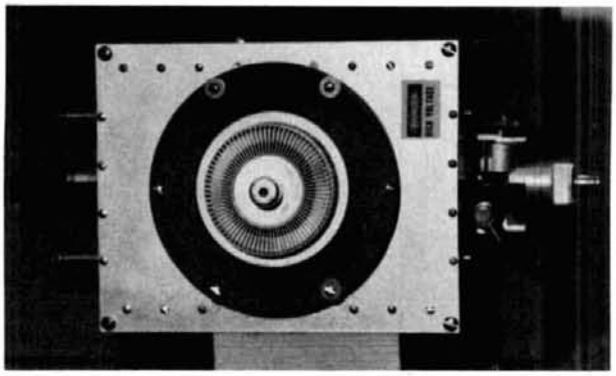

fig. 3. Top view of cavity with tube installed. The screws with washers are the support screws for the top cabinet. The double line section for measuring forward and reverse RF power output is visible on the right.

chassis (**fig. 3**). The cavity is thus mounted to the chassis by four screws into the standoffs at the four corners of the cavity top plate and four screws coming up through the bottom of the chassis and through the EMI filter.

The blower (265 CFM) is attached to a mounting plate (**figs. 4, 5**) fastened to the rear of the chassis. A hole to match the blower output size is cut into the mounting plate and the chassis. No screen is required over the chassis air input since the EMI filter performs this function. An air switch is mounted in the output air stream of the blower.

An auxiliary blower (55 CFM), shown in **fig. 6**, is mounted on top of a small cabinet measuring 4 × 5 × 6 inches (10.2 × 12.7 × 15.2 cm). The bottom plate of this cabinet is not used. The cabinet is mounted on top of the insulating ring of the cavity using four of the six insulating ring mounting screws. These four mounting screws are replaced with slightly longer screws to permit a secure mounting while avoiding any protrusion into the cavity. A hole is punched in the top cover of the cabinet to match the fan blade diameter. The blower is mounted to the top cover by securing it with adhesive to felt strips around the periphery of the blower. These felt strips have an adhesive backing that provides secure fastening to the cabinet top. (Care must be exercised to trim the strips so that the fan blade will not catch on the felt.) The blower is mounted, of course, so that the air stream flows upward.

The cabinet discussed protects users from the high voltage to the anode of the 8938. The MHV type connector is mounted on a small box on the rear of the cabinet. The 0.001/4 kV feedthrough capacitor and a small screw fasten the small box to the cabinet. The feedthrough capacitor is positioned slightly above the level of the tube anode. A five-turn, 1/4-inch diameter (1-inch long) RFC is connected between the capacitor and the anode connecting clip.

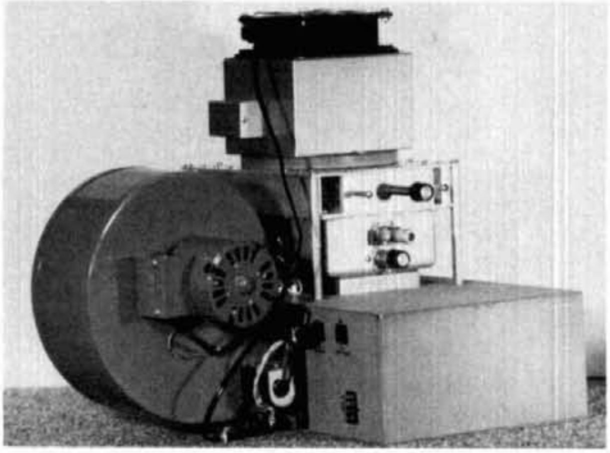

fig. 4. Rear and left side view. Air switch mounted on blower is visible. Also blower connections. The upper control on the cavity is the tuning control. Below it is the RF input and load control. Next below is the cathode tuning control.

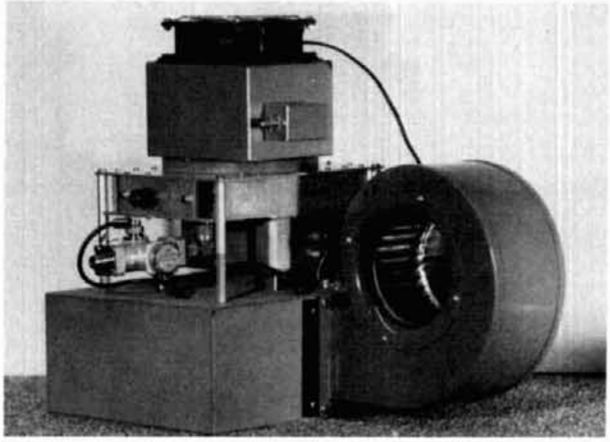

fig. 5. Rear and right side view. The double line section is visible, attached to the cavity RF output connector. Above it is the cavity load control. Just in front of the large blower are the heater cathode terminals on feedthrough capacitors. The high voltage MHV connector mounted on the small box on the upper cabinet is also in view.

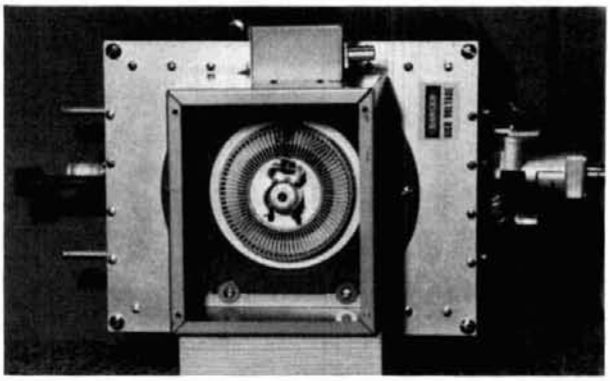

fig. 6. The top view with the auxiliary blower removed shows the HV connection to the tube through an RF choke. Also shown is the method of mounting the small upper chassis box to the cavity. (Don't be confused by the wood block used to support the cavity for the picture.)

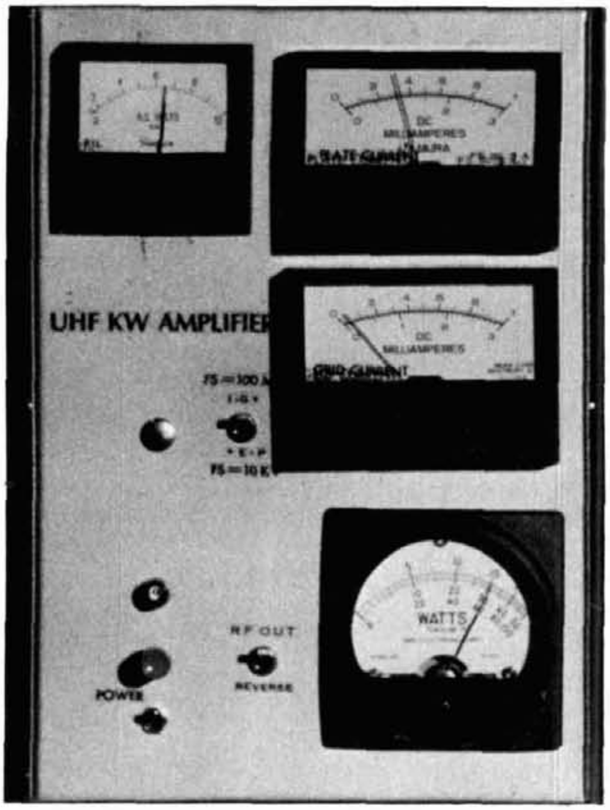

fig. 7. Front view of control unit. Note that the amplifier is in operation with 1500 watts output at 1-ampere plate current and 6-mA grid current.

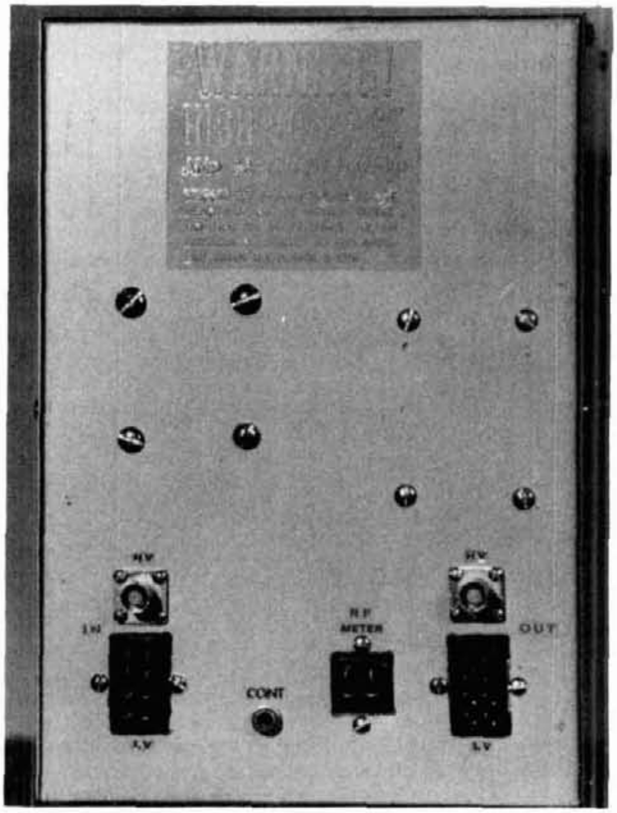

fig. 8. Rear view of control unit.

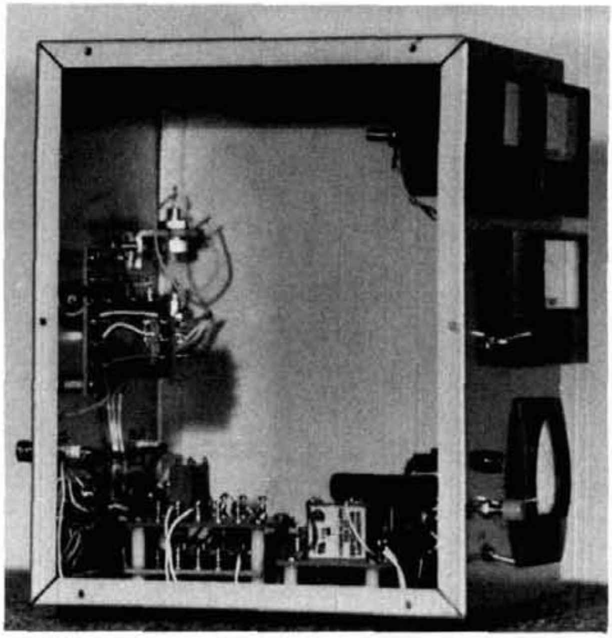

fig. 9. Left side of control unit with cover off.

Three C-J connectors are mounted on the rear of the chassis (**fig. 4**). The cable from the blower is shown plugged into a four-conductor C-J connector. This cable furnishes 120 VAC to the blower motor and provides connection to the air switch. The 120 VAC is bridged to a two-conductor C-J connector to furnish power to the auxiliary blower. The other four-conductor C-J connector, to the right of the blower connector, connects to the RF power output forward and reverse RF meter elements of the double line section, which is connected to the RF output connector on the cavity. The output connector on the cavity is of the HN type. A right-angle HN adapter connects and supports the double line section, which is equipped with an HN type QC connector. The RF output connector on the line section may be either HN or N, with HN recommended. The eight-conductor low voltage connector is also visible on the rear of the chassis. The interior of the chassis is vacant except for the wiring to the C-J connectors. The small openings in the chassis at the corners are sealed with plastic tape to prevent air leakage.

control unit

The control unit (**figs. 7, 8**) is assembled in a cabinet measuring 7 × 8 × 10 inches (17.8 × 20.3 × 25.4 cm). The circuitry is divided into sections mounted on individual terminal boards as follows:

- metering and stand-by bias switching control on a two-section board;
- high voltage failure protection on two single-section boards, one mounted over the other;

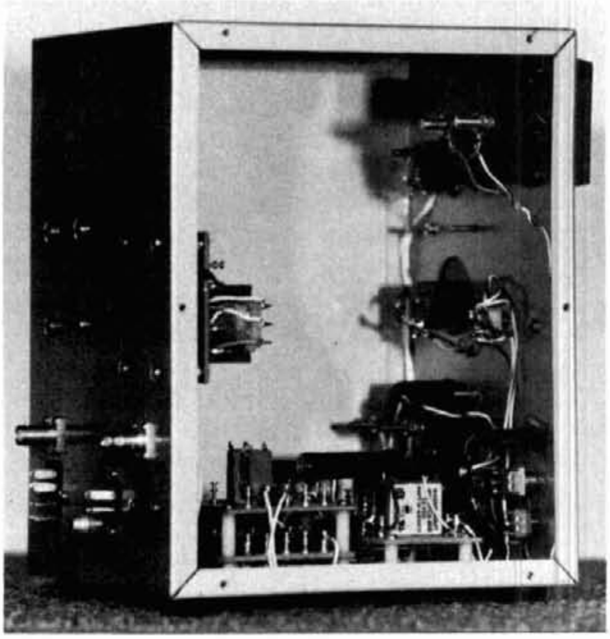

fig. 10. Left side of control unit view from rear.

• 12 VDC supply on a single board.

The two 50-watt zeners are mounted on brackets secured to the rear of the cabinet. One of the zeners is visible in **fig. 9** and **10**. The other is obscured behind

fig. 11. Power supply. The control locations marked BIAS, CONT and SCR are not used in this application. The BLOWER outlet is also not used since the two blowers on the amplifier chassis are powered over the cable connector marked LV.

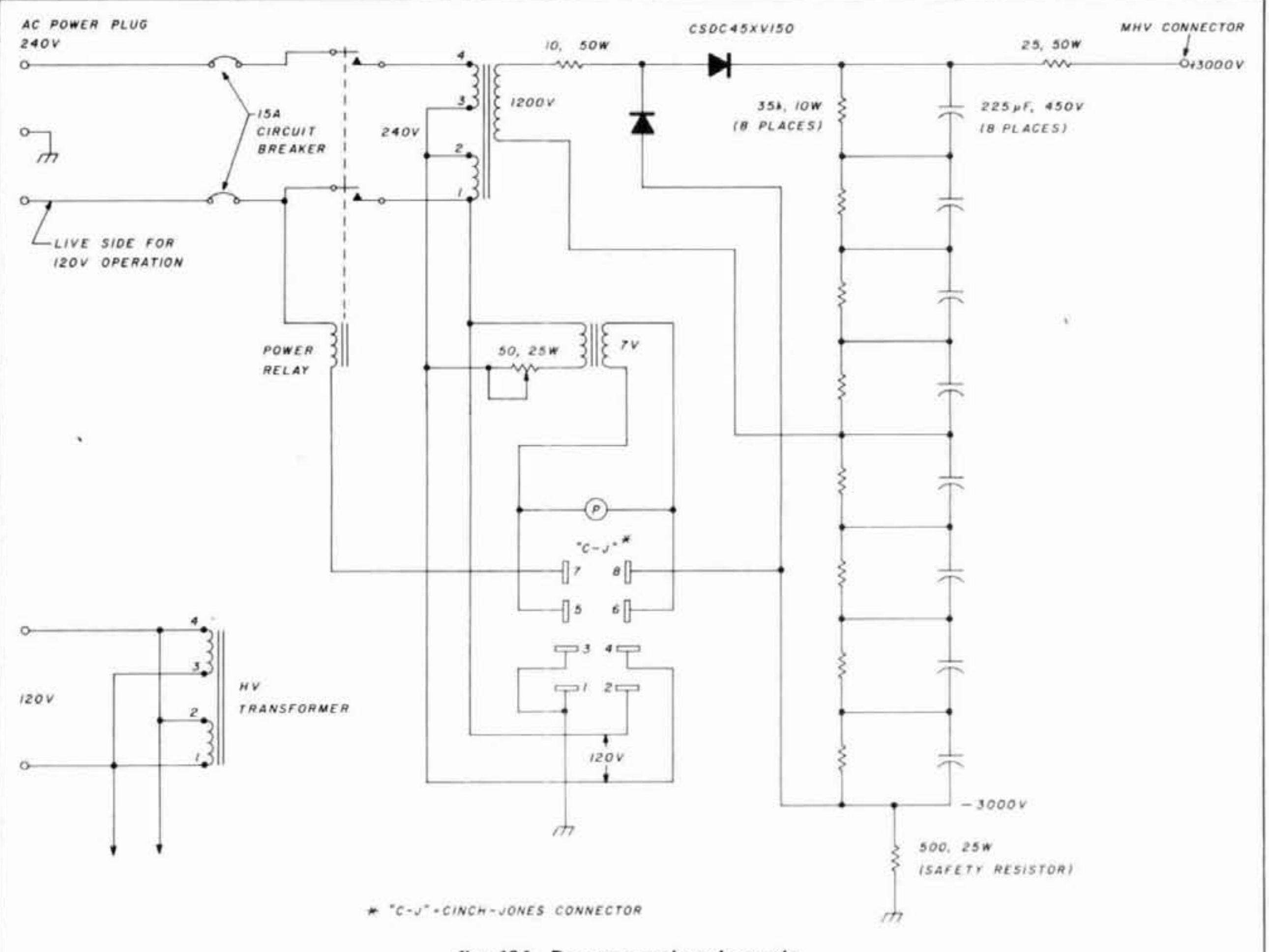

fig. 12A. Power supply schematic.

the 12 VDC board. Two 13-volt zeners in series provide the 26-volt cathode bias.

The mounting of the meters and switches on the front panel and the connectors on the back may be observed from the photos. Meter scales are as follows:

- plate current 0-3 amperes
- grid current 100 milliamperes
- plate voltage 10 kilovolts (read plate voltage by depressing non-locking switch next to the meter)
- heater voltage 0-10 volts AC
- RF output 2500 watts forward, 250 watts reverse (read reverse by depressing non-locking switch next to the meter)

The small toggle switch on the front panel at the lower right (**fig. 11**) prepares the circuitry for operation of the power relay in the power supply. When depressed, the non-locking push-button switch above the power switch causes the power relay to energize the power supply. As the blower comes up to speed, the air switch engages and locks the power relay up after the release of the push-button switch. The amplifier is thus protected from air supply failure.

Note: the schematic (**fig. 12B**) shows the transistor connected through a 15-megohm resistor to the high voltage line. When high voltage is present, this transistor conducts, activating its associated relay. When this relay is energized, operating bias is applied to the amplifier through another relay which is powered on by a closure to ground of the control jack during transmit. The high voltage portion of this circuitry protects the 8938 tube in case excitation is applied and high voltage is not on.

The metering and other protective features are standard for a grounded grid triode amplifier and may be observed by analyzing the schematic.

power supply

The power supply (**figs. 11** and **12A**) is capable of providing 1 ampere at about 3000 volts CCS (continuous commercial service). The voltage doubling circuit, with a net of about 25 μF of filter capacity, has three protective resistors: 10-ohm 50-watt diode protection,

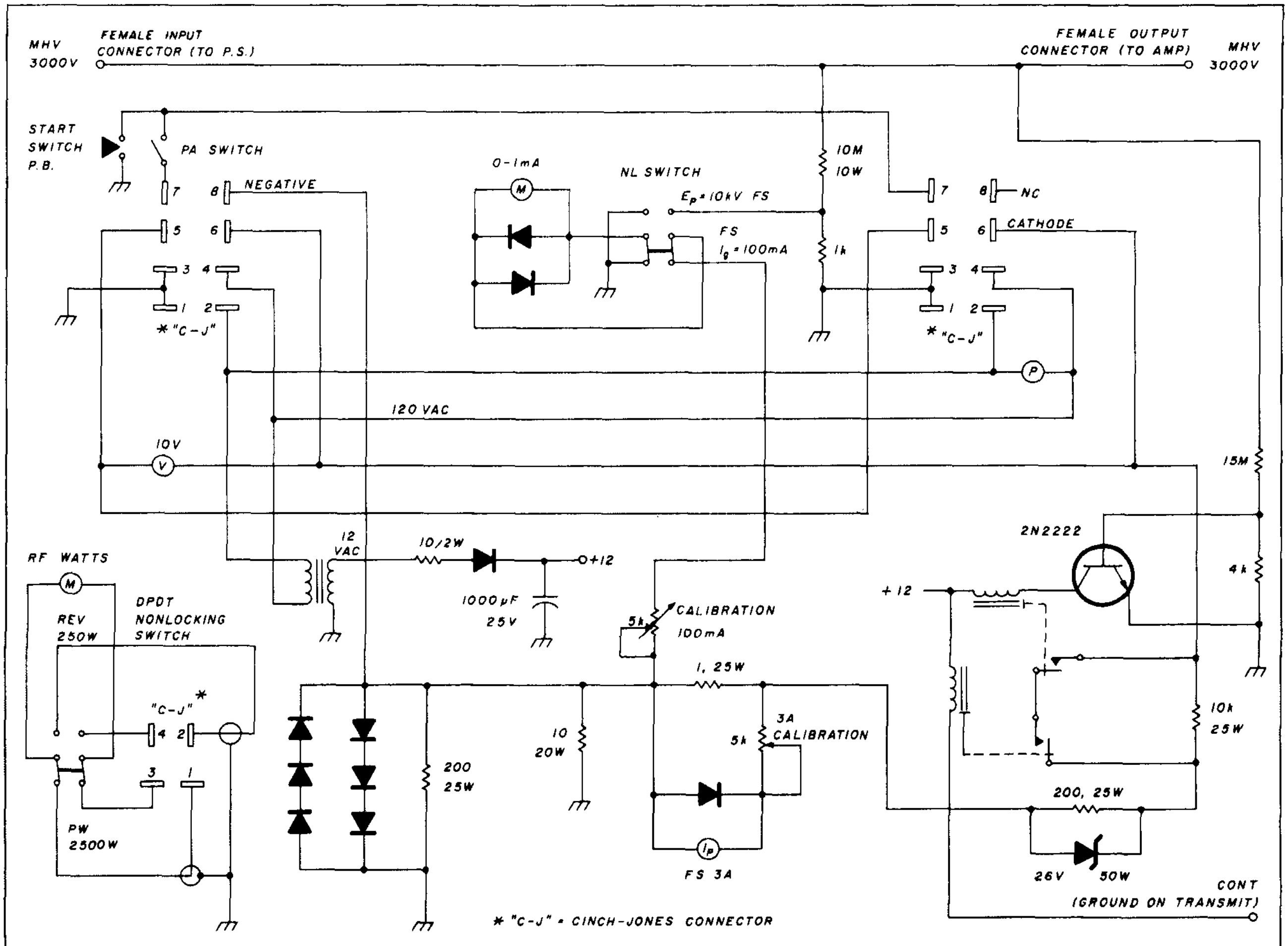

fig. 12B. Control and metering schematic.

25-ohm 50-watt output short circuit protection, and a 500-ohm 25-watt from negative to chassis for safety. The rest of the circuitry can be easily determined from a review of the schematic.

Power supply parts are mounted in a 17 × 10 × 3 inch (approximately 43 × 25 × 7 cm) steel chassis with a ventilated cover. The transformer should have a 3 kVA rating ICAS (intermittent continuous Amateur service). The unit shown in **fig. 11** weighs a bit over 50 pounds, or 22.68 kilograms.

operation

To power up the amplifier, place the two power supply circuit breakers in the on position. Place the power switch on the control unit in the on position. Push the non-locking push-button switch on the control unit in and hold until the blower comes up to speed. Release the push-button switch and allow a minimum of three minutes warm-up time. Check plate voltage by placing the switch near the grid current meter in its non-locking position. Observe the heater voltage. Because of voltage drop between the control unit and the cavity, it will read (typically), 6.5 VAC when the voltage at the cavity terminals is 4.6 The reading of the heater voltage at the control unit will, obviously, vary with the length of cable between the two units. This irregularity can be avoided by providing a pair of wires in the cable to connect the cavity terminals directly to the voltmeter (see **fig. 12C**).

The amplifier requires a driver capable of providing 100 watts, a control cable, and a dummy load that can handle 1500 watts at this frequency. The amplifier is now ready to be tested.

After warm-up, apply the control signal (ground) but do not apply drive to the amplifier. Observe an idling current of about 0.125 ampere. With a drive power of 10 to 15 watts, adjust the cathode tune and load controls for a rise in plate current. Do not exceed 0.5 to 0.75 ampere of plate current during preliminary tests. Next, adjust the plate cavity tune and load con-

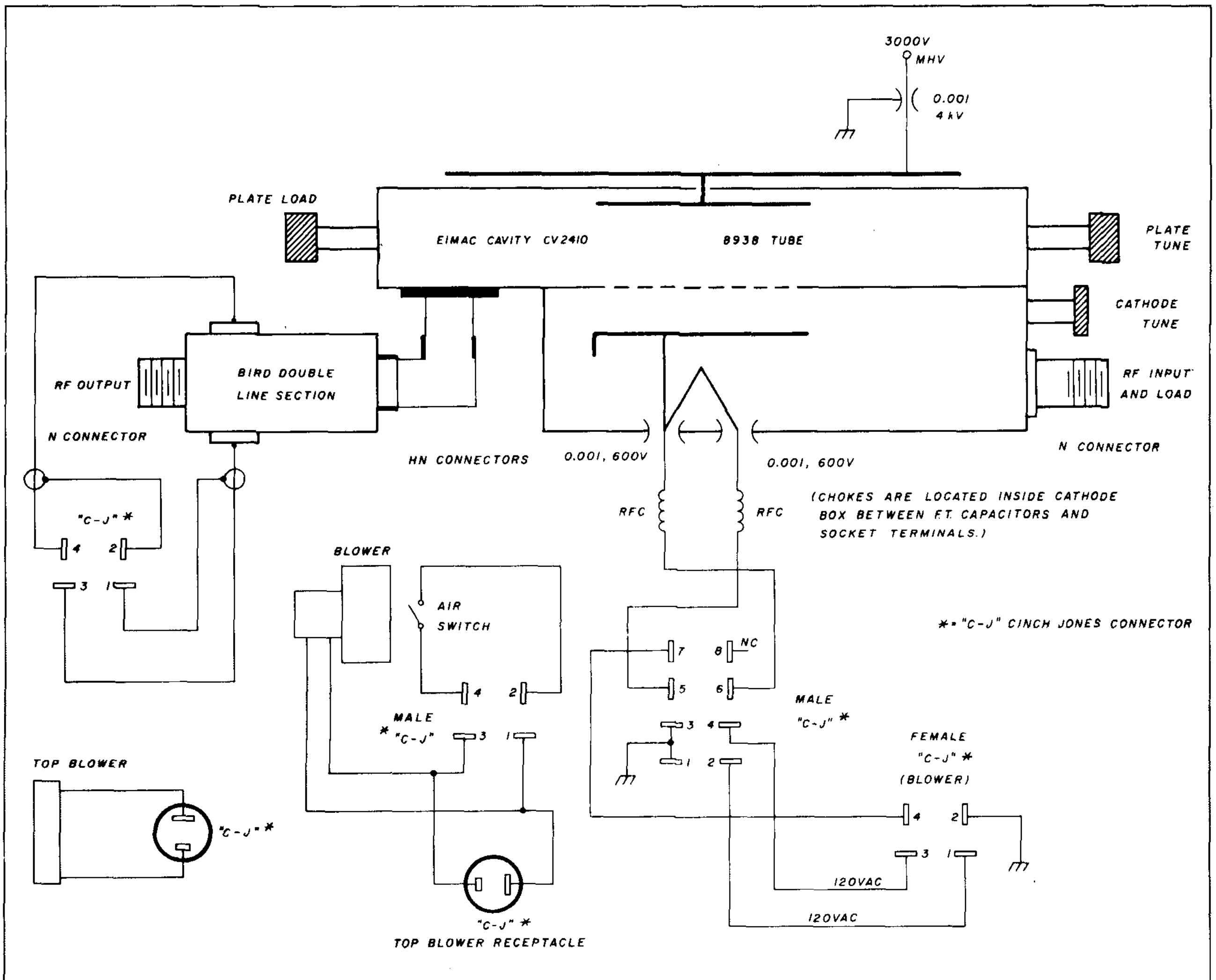

fig. 12C. Cavity and blower schematic.

trols for an indication of output power. From this point on, the usual format of amplifier adjustment is followed. Optimize the load and tune controls as the drive power is increased until 1500 watts of output is obtained at nominal plate current. The reverse RF power on the drive side of the amplifier will be close to zero. Typical readings at 1500 watts output are as follows:

- drive power, 100 watts
- plate voltage, 2800
- plate current, 1.00 ampere
- grid current, 6 milliamperes

With these readings, the efficiency is 54 percent and the power gain is about 12 dB.

It is suggested that adjustments to the plate cavity be made in steps with the drive power *off*. The mounting of the RF unit should be done in such a manner that the plate cavity cannot be inadvertently contacted by the body during operation.

The tests on this amplifier had to be limited to a maximum of 2 minutes (key down) because my dummy load was rated at one kW dissipation. However, a few very short "shots" of higher drive power showed outputs of up to 2500 watts. Dick Frey, W2SZ/1, super-VHF/UHF contester of Mount Greylock, Massachusetts, said, during one of the tests, "Man, there's an amplifier that sez *'gimme more!'*"

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micros and VHF beacons transmit messages automatically

Tied to beacons, micros find best times to dump data and predict best times for data transmission

Like many other Amateurs, I purchased a home computer several years ago. I started with a VIC-20 and now have several VIC-20 and Commodore 64 computers. My machines have been used for many applications, including several in the hamshack.

For high-frequency work, the availability of Bob Rose and Associates' "MINIMUF" program has been a blessing.[1] Many others have written improvements to the basic algorithm that make it even more versatile. But except for some simple programs for calculating repeater coverage and such, the use of computers in VHF propagation studies has been largely ignored.

radio link for program exchange

My brother Jon, WB9YJC, an electrical engineering student, has been bitten by the computer bug too, and uses both a VIC-20 and Atari 400 in his Amateur activities. Because we often work on developing programs together, but live 70 miles (112 km) apart, we found program exchange by mail much too slow, and telephone communication too expensive. A 2-meter data link seemed a likely way to solve the problem of keeping in touch.

Here in the Midwest, this would seem to be a reasonable solution. But other considerations — particularly antenna height limitations — can make the 2-meter data link more difficult than it might initially appear to be.

```
100 OPEN 2,2,3,CHR$(128+35):T7=37136:T9=37138:PRINT"J"
110 PRINT"ENTER TIME":INPUT TI$:PRINT "J"
120 A$="":GOTO 200
130 POKE T9,PEEK(T9)OR32:POKE T7,PEEK(T7)AND32
140 FOR X=1TO1000:NEXT
150 PRINT#2," DE KZ9XYZ BEACON SPRINGFIELD,";
155 PRINT#2," ILL TRANSMITTING FOR PROPAGATION STUDY";
160 PRINT#2," U*U*U*U*U*U*U*U*U*U*U*U*U*";
165 PRINT#2," U*U*U*U*U*U*U*U*U*U*U*U*U*";
170 PRINT#2," DE KZ9XYZ BEACON SPRINGFIELD ILL AR"
180 FOR Z=1TO12000:NEXT Z
190 POKE T9,6:GOTO120
200 GET#2,A$:IF A$=""THEN 200
210 PRINT TI$,
220 GET#2,A$:IF A$<>""THEN 220
230 GOTO 130
240 REM ***************
250 REM *             *
260 REM * "KERCHUNK"  *
270 REM * (C) 1985    *
280 REM * JIM GRUBBS  *
290 REM * PO BOX 3042 *
300 REM * SPRINGFIELD *
310 REM * IL 62708    *
320 REM *             *
330 REM ***************

READY.
```

fig. 1. This program listing for either the VIC-20 or the C-64 implements the Kerchunk program explained in the text. It is designed to be used with a Kantronics interface. You can substitute your own message in lines 150, 160, and 170.

Both of us have busy schedules, and our free times seldom coincide. Before we could use a radio link for program exchange, we would first need to establish that a predictable, everyday path would be possible, and then determine the best times and conditions for transmission.

The first breakthrough came when Jon suggested installing a computer-controlled beacon at his QTH. A simple CW program with some timing subroutines for his VIC-20 soon placed WB9YJC/Beacon on the air. A modification of one of my own programs soon put my signal on the air as well, and although the preliminary results were not very good, we at least had a "semi-reliable" signal for which we could listen.

I say "semi-reliable" because with Jon's VIC-20 tied up as a beacon controller, he was unable to use it for any other purpose. His Atari 400, on the other hand, was seldom used. To take advantage of its availability,

By Jim Grubbs, K9EI, P.O. Box 3042, Springfield, Illinois 62708

an Atari version of the Morse-code beacon was developed and the VIC-20 was freed for other uses.

As time permitted, we were then able to observe the path between us anytime, day or night. With only 10 watts on each end and a directional antenna on only one end of the path (his end), we were not very successful. It was obvious that improvements would be necessary.

While I contemplated additional power and an improved antenna system, Jon raised his antenna by 10 feet (3.05 meters). His signal was now up noticeably.

automatic signal logging

In the absence of an operator on either end to confirm reception, the effectiveness of our beacons was still limited. Some sort of logging system needed to be devised, at least on one end, to record times of reception when on operator was present.

My station consists of a VIC-20, a Kantronics interface, and a 10-watt transceiver. By having the VIC-20 constantly searching out input from the Kantronics interface — i.e., an incoming signal — a crude form of carrier operated (actually a voice or noise operated) relay could be built, using software.

When the squelch opened on an incoming signal, audio was fed to the interface. White noise coming through a terminal unit fortunately appears to the computer as random ASCII characters. By using a simple GET loop from the RS-232 port, the presence of an incoming signal could be noted. Using the TI clock in the VIC-20, the time of reception could then be logged directly on the screen or sent to a printer.

With my station operating in the "kerchunk" mode, it was now possible for me to know whenever my system "heard" an incoming signal or, at least, noise. Each time it heard an incoming signal, it would respond with a brief ASCII message; partial automation, with some unmanned vertification of results, had been achieved. But just as repeater kerchunking may invite abuse, so might this type of operation. A more complete solution was obviously required.

autorespond program

Jon used his knowledge of assembly language to design an ASCII program for the Atari 400. Not having an assembler for the Atari, he assembled the program on the VIC-20 and then transferred it to the Atari, a neat trick possible because both machines are built around the 6502 processor. The WB9YJC/Beacon was now transmitting in full ASCII, using an AEA CP-1 interface.

Meanwhile, I was developing a positive autorespond program — in reality, just an improvement on the earlier monitoring program. Borrowing from an input routine I designed for a landline-based bulletin board program, the program now constantly listens for a specific sequence of characters; old RTTY operators will recognize it as SELCAL.

In operation, the reception of a carriage return clears the memory. The next four characters are then re-

```
100 OPEN 2,2,3,CHR$(128+35):T7=37136:T9=37138:PRINT"⌐"
110 PRINT"ENTER TIME":INPUT TI$:PRINT "⌐"
120 A$="":GOTO  200
130 POKE T9,PEEK(T9)OR32:POKE T7,PEEK(T7)AND32
140 FOR X=1TO1000:NEXT
150 PRINT#2," DE KZ9XYZ BEACON SPRINGFIELD, ILL";
155 PRINT#2," TRANSMITTING FOR PROPAGATION STUDY";
160 PRINT#2," U*U*U*U*U*U*U*U*U*U*U*U*U*U*";
165 PRINT#2," U*U*U*U*U*U*U*U*U*U*U*U*U*U*";
170 PRINT#2," DE KZ9XYZ BEACON SPRINGFIELD ILL AR"
180 FOR Z=1TO12000:NEXT Z
190 POKE T9,6:GOTO120
200 LN=4:GOSUB 230
210 IF A$="NNNN" THENPRINT TI$,:FORD=1TO3000:NEXT:GOTO 130
220 GOTO 200
230 A$="":Y$=""
240 GET#2,Y$
250 IF Y$="" THEN GOTO 240
260 IF Y$=CHR$(13) THEN RETURN
270 IF Y$<" " OR A$>"Z" THEN GOTO240
280 A$=A$+Y$:IF LEN(A$)>LN THEN RETURN
290 GOTO 240
300 REM ***************
310 REM *             *
320 REM * AUTORESPOND *
330 REM * (C) 1985    *
340 REM * JIM GRUBBS  *
350 REM * PO BOX 3042 *
360 REM * SPRINGFIELD *
370 REM * IL 62708    *
380 REM *             *
390 REM ***************

READY.
```

VIC-20 or Commodore-64 computer and Kantronics interface will respond to a preset turn-on code. The code is located in line 210 (NNNN in the example). It can be any four letter code of your choosing. It must begin and end with a carriage return when sent by the distant station. The response message in lines 150, 160, and 170 can be changed to suit your needs.

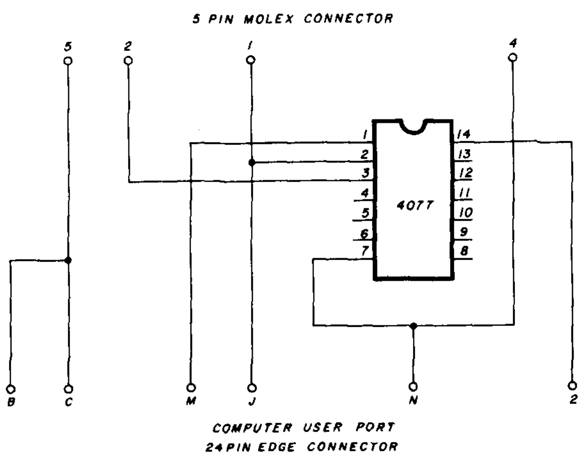

fig. 3. Interface circuit to connect your Commodore computer to the Kantronics interface. It requires a single 4077 integrated circuit and connects to the 24-pin user port located on the rear of your computer. Power for the IC is supplied from this connector also.

ceived and matched to the SELCAL being used, unless another carriage return is received. If another carriage return is received, the program simply starts over again. The sequence must be terminated by a carriage return in order for the match to take place. The addition of a simple sequence on the end of Jon's beacon message causes my station to autorespond.

Just as in "kerchunk," autorespond logs the activation time to the screen. Now, of course, there is reasonable certainty that the activation is caused by the signal at the other end of the path, rather than random noise or other signals.

It is a simple matter to include the time in the response message. The station on the other end can then check the screen or printer for the presence or absence of a response, with the time duly noted.

The sound of the autorespond program in action reminds me of the chirping that takes place with AMTOR stations, only much slower. It might be described as a "burp" rather than a "chirp!"

programs

Figures 1 and **2** are sample programs reflecting the developments discussed above. Note that these programs, written for the VIC-20 and Commodore 64 computers, were specifically designed to work with the Kantronics interface.

For ease of program development it's necessary to use the RS-232 user port on the VIC-20 and Commodore 64 rather than the joystick port as many commercial software products do. A connection diagram for matching the VIC-20 and Commodore 64 to the Kantronics interface in this manner is shown in **fig. 3**.

Applying these techniques to other computers will require the writing of individualized programs.

plans for future programs

Our automated propagation study has been very helpful in assessing and continuing to assess equipment requirements and best times for data transmission.

We have found that AMTOR, although somewhat slow, allows us virtually 100 percent accurate transmission as long as we have any signal at all. Knowledgeable hams have walked into the room during AMTOR reception and sworn that no audible tones were present, even as error-free text was being displayed on the screen.

Our experiments have been successful enough that I am now able to run an MSO program for Jon to access and leave messages. A similar operation is planned for his station.

The next step will be a combination of beacon and MSO techniques. We are currently developing software that will leave both stations idle until one or the other station is loaded with a message for transmission. When one or more messages are loaded, the originating station will begin sampling conditions by transmitting a beacon message every five minutes or so. Upon receipt of an acknowledging message from the distant end, the traffic will be transmitted with a check sum. If successfully received, the check sum will be echoed back. The program will allow for several attempts to occur before reverting to the beacon mode. Once the message or messages have been received, both stations will return to monitoring condition.

closing remarks

Why not put that computer to work doing something other than logging contacts? The application described here only begins to suggest the possibilities inherent in using low-cost micros for Amateur Radio application. Perhaps our experience will encourage you to try some of these techniques.

reference

1. Robert B. Rose, K6GKU, "MINIMUF: A Simplified MUF-Prediction Program for Microcomputers," *QST*, December, 1982, page 36.

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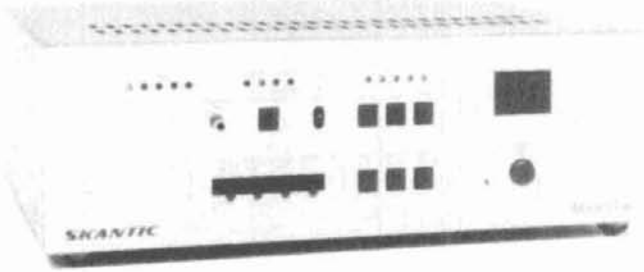

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Large Capacity Display Memory: Covers up to 1,280 characters. Screen Format contains 40 characters × 16 lines × 2 pages.
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Function Display System: Each function (mode, channel number, speed, etc.) is displayed on the screen.
Printer Interface: Centronics Para Compatible interface enables easy connection of a low-cost dot printer for hard copy.

Wide Range of Transmitting and Receiving: Morse Code transmitting speed can be set from the keyboard at any rate between 5-100 WPM (every word per minute). AUTOTRACK on receive. For communication in Baudot and ASCII Codes, rate is variable by a keyboard instruction between 12-300 Baud when using RTTY Modem and between 12-600 Baud when using TTL level. The variable speed feature makes the unit ideal for amateur, business and commercial use.
Pre-load Function: The buffer memory can store the messages written from the keyboard instead of sending them immediately. The stored messages can be sent with a keyboard command.
"RUB-OUT" Function: You can correct mistakes while writing messages in the buffer memory. Misspellings can also be erased while the information is still in the buffer memory.
Automatic CR/LF: While transmitting, CR/LF automatically sent every 64, 72 or 80 characters.
WORD MODE operation: Characters can be transmitted by word groupings, not every character, from the buffer memory with keyboard instruction.
LINE MODE operation: Characters can be transmitted by line groupings from the buffer memory.
WORD-WRAP-AROUND operation: In receive mode, WORD-WRAP-AROUND prevents the last word of the line from splitting in two and makes the screen easily read.
"ECHO" Function: With a keyboard instruction, received data can be read and sent out at the same time. This function enables a cassette tape recorder to be used as a back-up memory, and a system can be created just like telex which uses paper tape.
Cursor Control Function: Full cursor control (up/down, left/right) is available from the keyboard. Test Message Function: "RY" and "QBF" test messages can be repeated with this function.
MARK-AND-BREAK (SPACE-AND-BREAK) System: Either mark or space tone can be used to copy RTTY.
Variable CW weights: For CW transmission, weights (ratio of dot to dash) can be changed within the limits of 1:3-1:6.
Audio Monitor Circuit: A built-in audio monitor circuit with an automatic transmit/receive switch enables checking of the transmitting and receiving state. In receive mode, it is possible to check the output of the mark filter, the space filter and AGC amplifier prior to the filters.
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ham radio TECHNIQUES

Bill Orr W6SAI

a fair shake?

The January 28, 1985 issue of *Business Week* had an interesting article that may be of great import to Radio Amateurs. The "Washington Outlook" column read in part:

Federal Communications Chairman Mark S. Fowler, concerned about the glacial pace of Japanese certification for U. S. communications products, is considering steps to stiffen existing U. S. licensing and regulations requirements. If Fowler lives up to his threat, the rule changes could slow Japanese telecommunications exports to this country to a trickle.

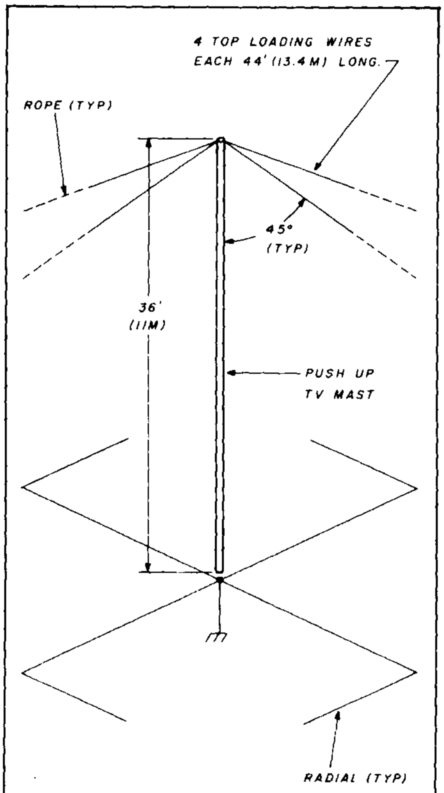

fig. 1. The W6PYK vertical antenna for 160 meters. Antenna is top-loaded TV mast. Base radials slope upward with ends 5 feet (1.5 meters) above ground level.

In the same article, Albert Halprin, Chief of FCC's Common Carrier Bureau said, "There is legitimate concern by U. S. manufacturers about whether they are getting a fair shake in other markets."

The article concludes with speculation that Senator John Danforth (R-Missouri) the new Chairman of the Senate Commerce Committee, may reintroduce legislation that would direct the Administration to take similar action against Japanese telecommunications products if U. S. manufacturers are subject to discrimination by Japan.

160 meters revisited

The 160-meter band is in the summer doldrums now, but will spring back to life this fall. More Amateurs are rediscovering this old but interesting band and are determined to operate on it during the coming months. But what antenna can you use on a band whose half-wavelength is about 246 feet at 1.9 MHz — and you live on a small city or suburban lot? Big antennas are great if you live in the country on plenty of acreage, but most hams aren't so lucky.

Paul, W6PYK, wrestled with this problem. His space was limited, and he didn't want to dig up the whole yard to bury a mess of radial wires. He started experimenting in 1983, when he lived in Kentucky, and continued his tests when he later moved to California.

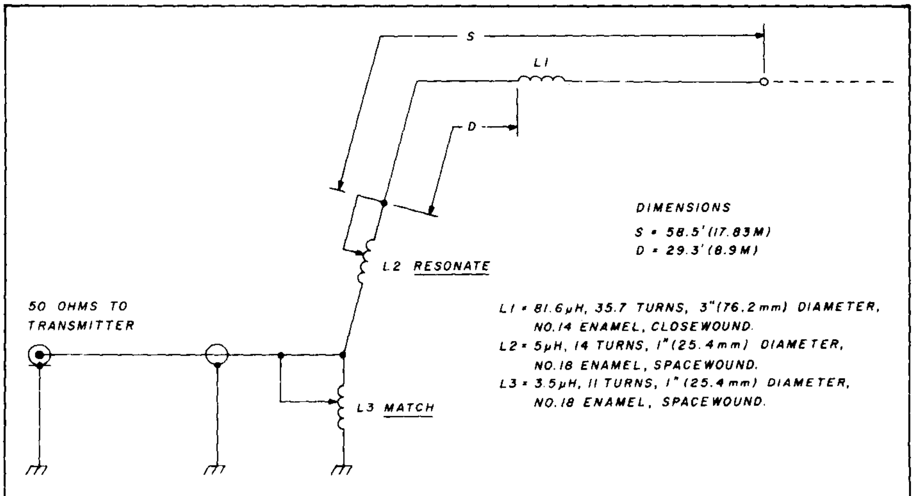

fig. 2. A compact Marconi-type antenna for the 160-meter band. Best results will be obtained with maximum amount of antenna wire in the vertical plane. Height of horizontal portion should be at least 25 feet (7.6 meters).

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DON'S CORNER

This month, Madison moves to newer and more luxurious quarters, with our new address at 3621 Fannin St. in Houston. Those of you who visited us at our old location on McKinney will greatly appreciate the increased parking, etc. etc. We'll miss our "legendary" McKinney location, but new times demand new store space, and we fully intend to keep up with the times.

New times also demand new modes of communicating to you, our customers, and so we continue to work on our MADISON/LINE Bulletin board. We're running a little behind on getting phone lines installed, and hardware up-and-running because of the move, but we should have all that ironed out shortly.

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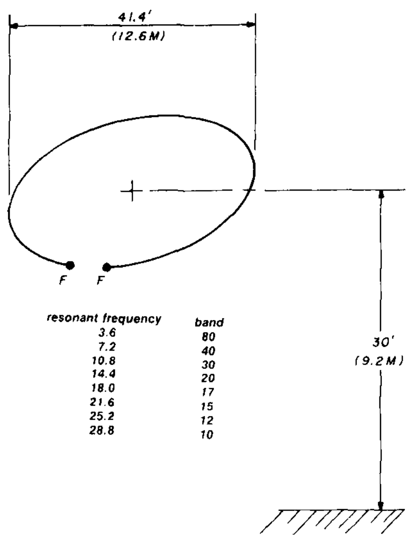

fig. 3. Horizontal loop provides all-band coverage from 80 through 10 meters, including new WARC bands. (Antenna tuner is shown in *fig. 4.*)

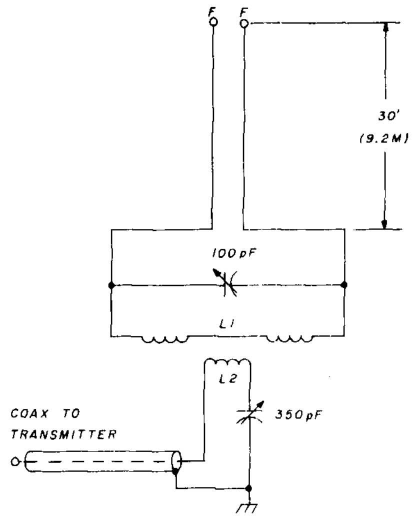

fig. 4. Link-coupled matching network. L1 is a 2-inch diameter coil consisting of two windings of 17 turns per inch. Coil L2 is 14 turns with same diameter. The whole assembly is made from a section of B&W 3026 miniductor stock. Coils are tapped to achieve resonance. (See *The ARRL Antenna Book*, 14th edition, pages 4.5-4.6 for construction details.)

Paul's basic antenna is a 36-foot (11 meter) high push-up TV mast. The theoretical feedpoint resistance of this antenna, working against a perfect ground is 9 ohms at 160 meters. In order to achieve this figure, he used top-loading, as shown in **fig. 1**. The four top loading wires served as guys for the mast.

As a starter, he used a single 8-foot (2.44-meter) long ground rod at the base of the vertical. The feedpoint resistance was about 55 ohms, a good match for a coax line, but a highly inefficient setup, as most of the transmitter power was lost in ground resistance. (The ground resistance is the difference between the theoretical feedpoint resistance for the given height and the observed value.) Antenna efficiency, then, is 9/55 = 16 percent.

Paul next disconnected his ground rods and added four base radial wires, close to the ground at the antenna base and about 5 feet (1.5 meters) above ground at the ends. It was necessary to bend the wires into a Z-shape to fit them on the property. The radials were each a quarter-wavelength long.

The feedpoint resistance was now about 13 ohms — a big improvement. Efficiency had risen to 69 percent.

This antenna obviously works. Paul has contacted three continents and many states running only 100 watts. He's now experimenting with a 65-foot (19.8 meter) tower in the same configuration.

a compact 160-meter Marconi antenna

When you have no room for a big antenna, small is best. You may not be Number One on the frequency with a small antenna, but you're on the air and can have plenty of fun. Here's a design for a coil-loaded Marconi antenna for the "top band" (**fig. 2**). The antenna is self-resonant at 2 MHz with the center loading coil L1. Series coil L2 at the feedpoint drops the resonant frequency as low as 1.8 MHz. And shunt coil L3 provides a match to a 50-ohm feedpoint.

An antenna can't be much simpler than this one. Its overall length is only 58.5 feet (17.8 meters). The antenna is bent into an "L" shape, with the horizontal portion 25 to 30 feet (7.6 to 9.2 meters) above ground. It has been used with success with the continuous metal plumbing system of the residence acting as a ground.

Adjustment is simple. Coil L2 tunes the antenna to resonance and coil L3 provides the correct impedance transformation to a 50-ohm feedpoint. The adjustments are slightly interdependent, but can be quickly accomplished with the aid of an SWR meter. Antenna operating bandwidth between the 2:1 SWR points on the feedline is about 50 kHz.

an "all-band" horizontal loop antenna

The virtues of voltage feeding an antenna have not been fully appreciated by the Amateur fraternity. When the voltage fed antenna is bent into a loop, a very interesting antenna results (**fig. 3**). This illustration shows a *horizontal loop antenna* about 130 feet (39.6 meters) in circumference. The harmonic resonant frequencies listed in the chart (see **fig. 3**) show that the loop provides resonance at, or near, the Amateur bands between 80 and 10 meters.

If desired, the loop can be made a bit smaller, with a portion of it being the feedline.

A simple antenna tuner is required to match the loop to a 50-ohm line (**fig. 4**). Resonance and coupling controls are adjusted in order to provide the lowest SWR at the transmitter.

Experimenters using this antenna will find that the resonant points are very broad at the higher end of the spectrum and that the resonant frequency of the loop can be "pulled" to almost any spot in the HF spectrum.

A loop twice this size, with a circumference of 260 feet, or 80 meters, exhibits twice the number of resonant frequencies and operates well at any frequency between 1.8 and 30 MHz with the proper antenna tuner. In all instances, the feedpoint of either antenna is at a high impedance.

The antenna need not be a perfect circle; it can be a many-sided polygon which encloses as much area as possible.

A simple and convenient feeder can be made up of a short length (30 feet, or 9 meters) of 300-ohm "ladder line" or perforated twin lead.

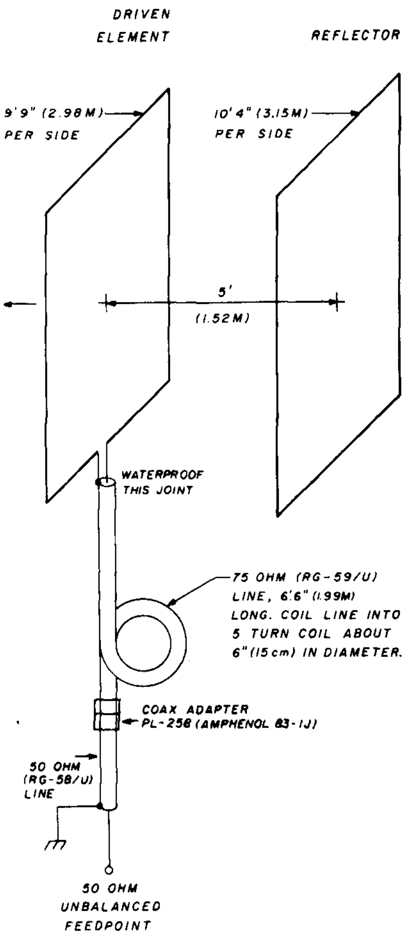

fig. 5. Simple 2-element Cubical Quad antenna for 24.9 MHz band.

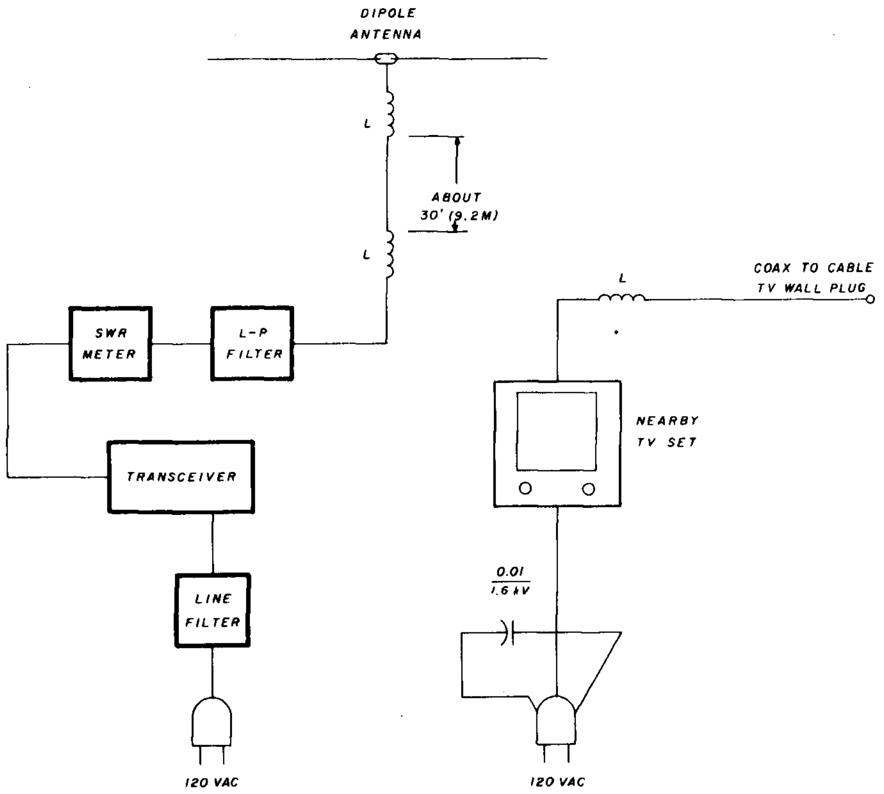

fig. 6. Line filters, plus winding coax lines into RF choke coils (L) clean up residual TVI after low-pass filter is placed in line with the transceiver.

a two-element quad for the 24.9-MHz band

With the opening of the 24-MHz band, there is considerable interest in a simple beam antenna that can be easily constructed and will provide good gain. The old favorite, the Cubical Quad, provides an inexpensive solution (**fig. 5**). The Quad provides a gain of about 7 dB over a dipole with a front-to-back ratio of approximately 15 dB. A quarter-wavelength transformer made of a section of 75-ohm line provides a good match to the Quad. The line is coiled up into an RF choke to reduce currents flowing on the outside of the outer shield of the line.

TVI revisited

How to clean up a bad case of TVI at a resort condominium? I had that problem last spring while on vacation. The rental condo had cable, but that didn't prevent the TV from going black and making funny noises when I fired up my transceiver on 20-meter SSB. Being prepared for such an eventuality, it took less than an hour to set things right. Here's what I did:

1. I placed a line filter — a three-section J. W. Miller, No. C-508-L — on the transceiver. I didn't have a second line filter for the TV receiver, so I made a simple one consisting of a line plug with a 0.01 μF, 1.6 kV disc ceramic capacitor wired across the prongs. I plugged this into the same outlet that fed the TV.

2. I then placed a low-pass filter in the coax lead from the transceiver to the antenna (a dipole). The filter was placed after the SWR meter, since the diodes in the meter can often generate TVI when it is not otherwise present.

3. The final step was to wind the coax (RG58C/U) into an RF choke at the point at which it joined the antenna. I made a five-turn coil, about six inches (15 cm) in diameter, held in position with electrical tape. A similar coil was made in the transmission line at the station end, just after the low-pass filter.

The installation is illustrated in **fig. 6**. It did the job! The TV was clean on all channels. If the TV had been on an antenna instead of on cable, a high-pass filter at the input terminals of the TV would probably have been necessary.

Coiling the coax line from transmitter to antenna into simple RF chokes was an important part of the solution. Without the coils, interference was noticeable on channels 2 and 4. When the chokes were in the line, the interference disappeared.

When the vacation was over, it was but the work of a moment to drop the dipole and remove the filter capacitor from the TV power plug. The two RF choke coils were left permanently in the dipole feedline and the Miller line filter was packed away with the transceiver for use on the next vacation trip.

ham radio

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Other accessories include the HS-10 boom headset, HS-10SB PTT switchbox, HS-10SA VOX unit (for IC-02AT) and an assortment of battery pack chargers.

The IC-02AT and IC-2AT come standard with an IC-BP3 NiCd battery pack, flexible antenna, AC wall charger, belt clip, wrist strap and ear plug. See the IC-02AT and IC-2AT 2-meter handhelds at your local ICOM dealer.

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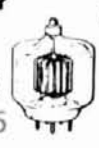

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a 50-500 MHz dual wattmeter

Having been interested in the 420-450 MHz band for some time, I finally succumbed to the UHF "bug" and bought a commercial FM HT to get on this band. Shortly thereafter I decided to build some sort of directional antenna system to make my HT more versatile. But a major stumbling block immediately arose: I had no SWR or power measuring capabilities for these frequencies. Because all the designs I could find called for assembly skills I do not possess, I decided to design my own device (**fig. 1**).

The heart of this circuit is the directional couplers (Mini-Circuits Labs No. PDC-10-1). These are 11.5 dB couplers (the sampled port is −11.5 dB down from the line) encapsulated in miniature metal cans. The coupling ratio is flat to within ±0.6 dB from 500 kHz to 500 MHz, and maximum power on the throughline is 3 watts from 5 to 500 MHz (1.5 watts below that). Thus this circuit will measure low power from 5.0 to 500 MHz directly.

The remainder of the circuit is a typical RF voltmeter. The HP-2800 microwave diodes rectify the sampled RF and charge the 0.01 μF capacitors. A DPDT switch selects trim pots for the ranges of 0.2 and 2.0 watts full scale. This set of ranges was chosen because meters calibrated from 0 to 20 watts, with a 100 μA movement, were readily available. (To make this a peak-reading wattmeter for SSB, replace the 0.01 capacitors with 6.8 or 10 μF electrolytics.)

construction tips

I strongly recommend the use of good quality double-sided fiberglass PC board, with one side (the bottom) etched and the other containing non-grounded holes countersunk to prevent shorts. All components are mounted on the ground-plane side. In the vicinity of the throughline, which will be carrying up to 450 MHz energy, I put several "Z" wire jumpers between top and bottom ground planes to prevent ground problems. After using the meter for several days, I added a shield of brass sheet (shim stock) over the RF throughline portion of the card. I can't really say I noticed much of a difference as a result.

Front and rear views of the completed wattmeter. Lettering is rub-on type; striping is 1/16-inch PC layout tape.

item	description
C1,C2	0.01 μF ceramic capacitors, 15 volt
CR1,CR2	HP-2800 or equivalent Schottky diodes
M1,M2	0-100 μA meters
R1-R4	50 kilohm trimmer potentiometers
U1,U2	Mini-Circuits PDC-10-1 directional couplers

Sources:
HP-2800: Megahertz Electronics, 2111 West Camelback Road, Phoenix, Arizona 85105
PDC-10-1: Mini-Circuits, P.O. Box 166, Brooklyn, New York 11235. Price: approximately $11.50 each in 5 to 45 quantity. (Singles about double that price.) Club or individual orders accepted.
0-100 μA meters — calibrated: Fair Radio Sales, 1016 East Eureka, Box 1105, Lima, Ohio 45802.

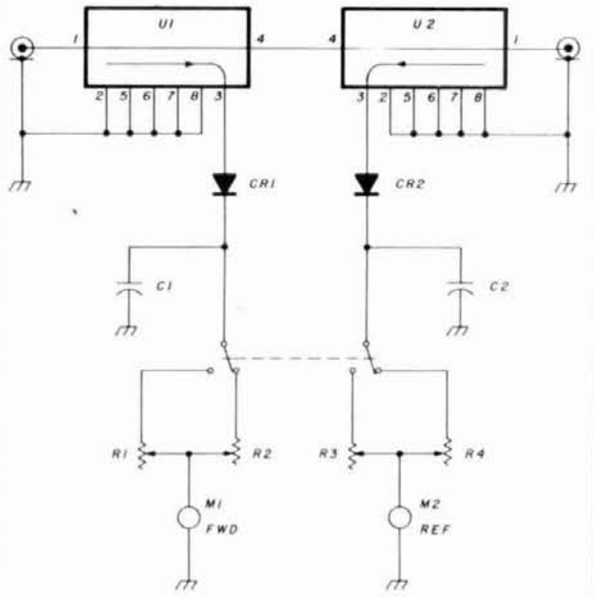


fig. 1. Dual wattmeter schematic.

By Bob Lombardi, WB4EHS, 1874 Palmer Drive, Melbourne, Florida 32935

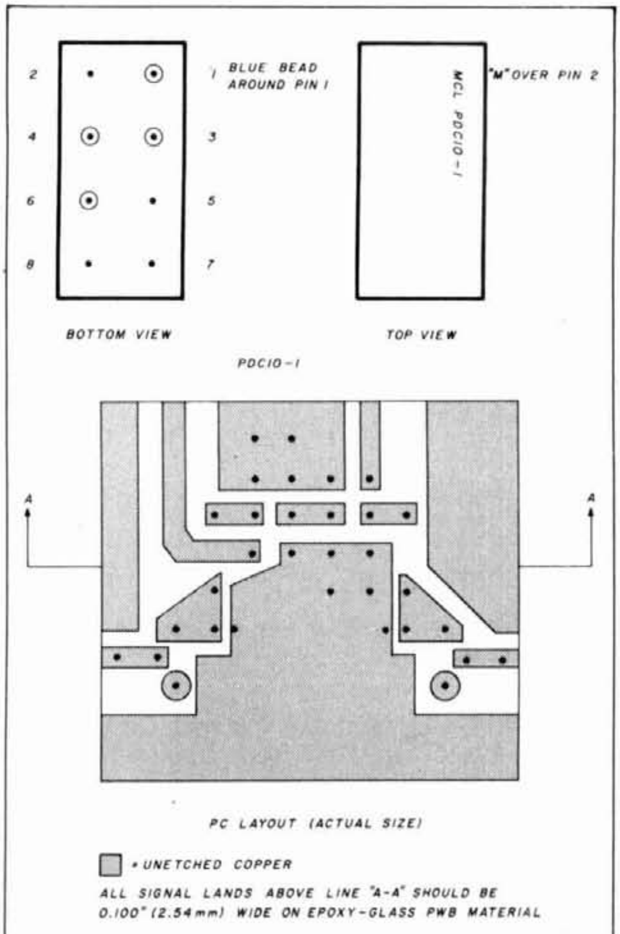


fig. 2. PC board layout (actual size).

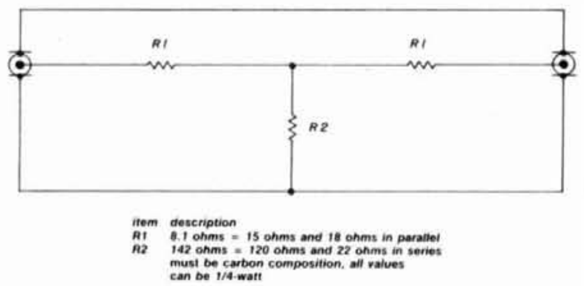


fig. 3. 3dB pad is a useful addition to meter.

It will be noted from the PC layout (**fig. 2**) that the directional couplers are mounted offset from parallel and case-to-case. The fact that one coupler is used for reverse voltage sensing dictates that they must be mounted with their part-markings in opposite directions. This minimizes the path that the RF must take through the meter. If you plan to use the meter only on 2 meters, this extra care in layout and shielding could probably be omitted.

You may notice that I've used SO-239 connectors instead of BNCs. Up to about 500 MHz, connector choice is a matter of just that — choice. A well-installed (i.e., short grounds with good shielding all around) RCA phono plug is as good as a BNC plug. Because I already had the connectors on hand, and am already good at installing them, I stayed with SO-239s. For higher power work, or serious weak-signal work on 432, I would probably switch to N connectors.

calibration and use

Since the meter response can vary with frequency, it's best to calibrate it on the band in which you are most interested. Terminate the output with a 50-ohm non-inductive resistor and calibrate the forward position to whatever your standard is known to be. I used a Bird Termaline wattmeter as standard at 446 MHz. Interchange the input and termination and do the same on the reverse meter. Do this on both ranges.

The calibration of this type of meter depends on line impedance. With purely resistive loads.

$$P = I^2R \text{ or } P = \frac{E^2}{R}$$

When R is not the 50 ohms with which we calibrated, the accuracy falls off. For any power measurements we make with the meter, it should always be terminated in 50 ohms resistive.

For tweaking antennas, a familiar equation is:

$$VSWR = \frac{1 + \sqrt{\dfrac{P_{REF}}{P_{FWD}}}}{1 - \sqrt{\dfrac{P_{REF}}{P_{FWD}}}}$$

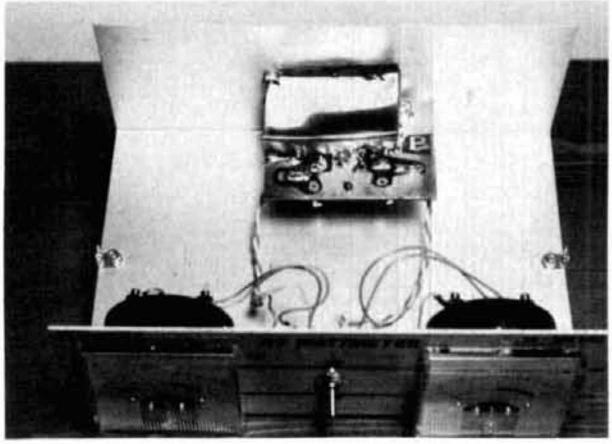
Charts are available in the literature for fast determination of VSWR for a given P_{REF} and P_{FWD}. This can be also done in seconds on a simple calculator. In most cases, however, all that's necessary is to observe the forward increase and reverse decrease in readings while working on the antenna (nulling VSWR).

In UHF work, it's important to remember that the SWR at the antenna will always be worse than the SWR at the meter unless the antenna and meter are very close — for example, if the antenna is mounted on the back of the meter box. For example, suppose you measure 2 watts forward and 0.05 watts reverse on a section of coax with 3 dB loss. Using these values, the equation gives us $SWR = 1.4{:}1$, which is probably reasonable. Taking the 3 dB loss into account, the forward power at the antenna is 1 watt, and the reflected power is 0.1 watt, (the 3dB works both ways). This gives an SWR of 1.9:1, which may or may not be acceptable.

For antenna testing, measure as close to the antenna as possible, and know (or better yet, minimize) losses.

other measurements

This circuit is useful for measuring powers above 2 watts if they are reduced to the 0-2 watt range before



Because my original version was only 2 watts full-scale, the PC layout shown in *fig. 2* is different. It's convenient to mount the pots on the switch; if you opt to do this, change the PC layout to accommodate the two sets of trimmers.

being applied to the meter. **Figure 3** shows a 3-dB attenuator for reducing 4 watts to 2 watts; this should handle just about all of the commonly used 2-meter HTs. It's best to calibrate your attenuator on your wattmeter by measuring power level of a known $\leq$ 2 watt source both with and without it in line. Mark the power factor (about two times) on the pad and multiply power measurements by that factor whenever using it. Of course, it's safest to take the first readings of any new source with the pad in line. It can then be removed if the source is less than 2 watts. Other types of couplers can be used to measure higher power levels: for example, a 10-dB coupler can be used to measure up to 20 watts, and a 20-dB coupler can be used for up to 200 watts.

conclusion

In-line wattmeters should not be used in VHF or UHF weak signal work because the losses are not tolerable. This unit works well in its intended applications — low power measurements and antenna tweaking. Likewise, with the proper choice of attenuators and couplers, it's useful for measuring other power levels in the 5 to 500 MHz range.

Mini-Circuits claims an insertion loss of 0.85 dB per coupler, or 1.7 dB for the meter. Input VSWR should be 1.2:1. I measured VSWR for my unit during calibration and found it to be about 1.3:1, within reason when the connectors and adaptors used are figured in. I wasn't able to measure insertion loss because of the plethora of cables and adaptors required.

This is an unusual circuit, the only one I'm aware of that extends alternative techniques to UHF in Amateur applications. All other Amateur circuits I could find required brass pipe and other hardware. There are plenty of 2-meter, 220 MHz, and 440 MHz HTs out there, with powers in the range of this instrument; I hope their owners find this project useful.

ham radio

More Details? CHECK—OFF Page 126

short circuits

July 1985

carrier suppression

In the April ham note (page 78), "Improved Carrier Suppression for the MC1496," *power* — not signal, as printed — is applied to the bifilar windings through a series choke arrangement.

July 1985

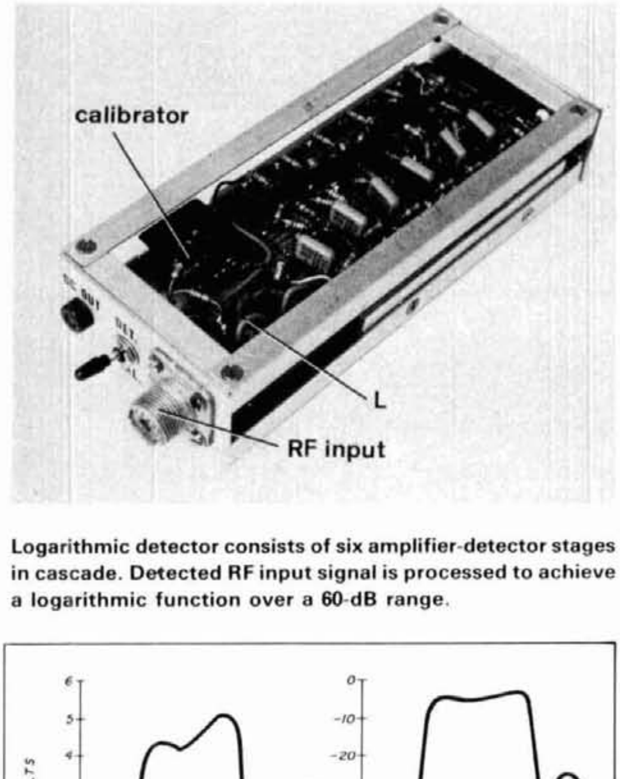
feeding phased arrays

The caption for **fig. 1B** of KB8I's article, "Feeding Phased Arrays: An Alternative Method" (May, 1985, page 59) should be revised to read as follows:

fig. 1B. Though high SWR exists on the main feeder, the matchbox now located in the shack can be switched over to and used with other antenna systems.

wideband logarithmic detector

Only six transistors provide a 60 dB log response



Logarithmic detector consists of six amplifier-detector stages in cascade. Detected RF input signal is processed to achieve a logarithmic function over a 60-dB range.

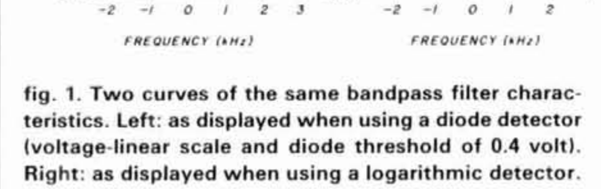


fig. 1. Two curves of the same bandpass filter characteristics. Left: as displayed when using a diode detector (voltage-linear scale and diode threshold of 0.4 volt). Right: as displayed when using a logarithmic detector.

The question of why a logarithmic detector would be desirable for filter sweep alignment may be best answered by considering the virtues of the decibel scale. With a logarithmic detector an oscilloscope display can show parts of the filter characteristic that an ordinary detector would probably ignore. The display may even reveal an entirely different and more realistic picture of the test results **(fig. 1)**.

Several methods are available for building a logarithmic detector. For example, one could consider using the nonlinear behavior of a diode (very much temperature dependent); a string of clamping diodes for correcting the DC detector output (amplitude-range limitations); using an LM3089[1] (which, unfortunately, decides to stop working properly below 10 MHz); or making a succession of amplifiers and detectors with the detector outputs connected in parallel.

I chose the last method. What may be unusual about this approach is the use of amplifiers that are not tuned to one particular frequency, as opposed to what is customary in applications such as spectrum analyzers or field strength recorders. These are wideband amplifiers, accepting signals with frequencies between 50 kHz and 14 MHz. It is not only the absence of coils that makes this little test box so simple. Only six transistors are necessary to realize a reasonably accurate logarithmic response over a range of almost 60 dB. **Figure 2** shows the general arrangement of the logarithmic detector. Final test results are depicted in **table 1**.

the principle

Starting off by experimenting with a common diode detector, I found that by adding a reversed-polarized diode, counteracting the curvature of the detector characteristic, a very reasonably logarithmic curve portion can be extracted, extending over a range of almost 10 dB **(fig. 3)**. Six amplifier-detector stages are connected in cascade. As each stage increases the RF signal amplitude by 10 dB, each detector processes

By Hans Evers, PA0CX/DJ0SA, Am Stockberg 15, D5165 Hürtgenwald, West Germany

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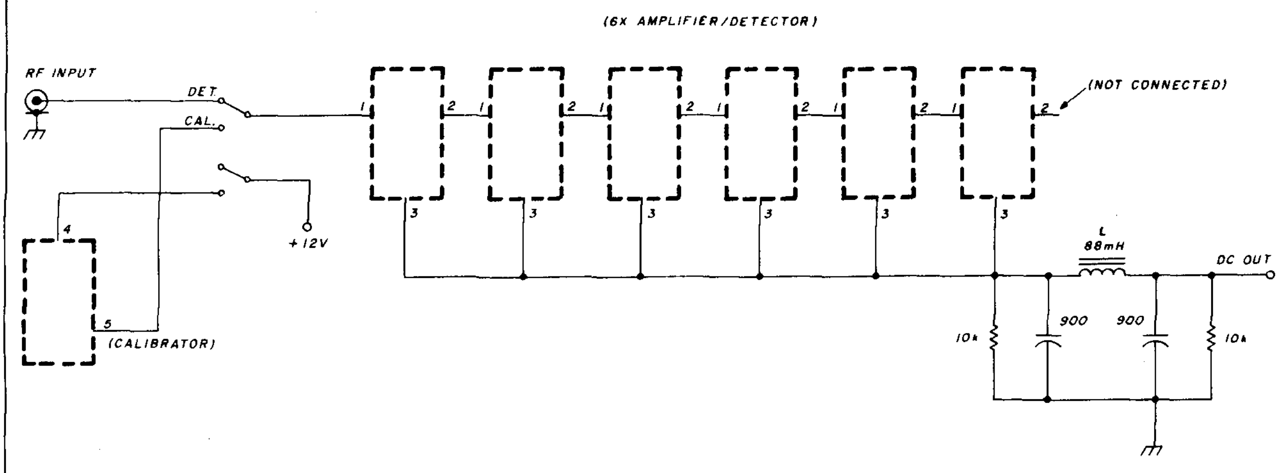


fig. 2. Schematic diagram of logarithmic detector. Circuit provides a 60-dB dynamic range. (See figs. 4 and 6 for details of amplifier/detector stages and calibrator unit.)

the signal with mainly the logarithmic portion of its characteristic. The detector outputs are combined, partly overlapping, compensating for the less desirable portions of their characteristics. This translates to a 60 dB range logarithmic conversion of an RF inputted signal. The reason for the 60-dB range is that it looked about right for Amateur Radio use. It covers the 9 S-units, plus an extra 6 dB. In practice, this represents sufficient dynamic range for determining carrier and unwanted sideband suppression, filter shape factors, and for detecting side lobes of crystal filters.

transient response

CR1 and C1 form a peak detector **(fig. 3)**. With R1 given, C1 must be adequately large for charging to the full signal peak voltage. If it is not, the detected DC voltage is no longer a true function of the RF amplitude. If, on he other hand, the RC time constant is too long, the circuit may not be capable of following the transients — *e.g.*, of those caused by the possibly steep skirts of a filter swept at a high rate.

In this case, the value of 0.001 μF for C1 allows an acceptable compromise between the lowest frequency (50 kHz) at which I decided that the detector should still be usable, and a transient response that should not take more than 0.5 millisecond to be fully displayed. In practice this means that using a (flicker-free) time base of 20 times per second, the amplitude could make a full-range jump in less time than it would take to displace the oscilloscope light spot horizontally by 1 percent. This makes the detector reasonably fast, so that it can even be used as part of a spectrum analyzer or panoramic receiver.

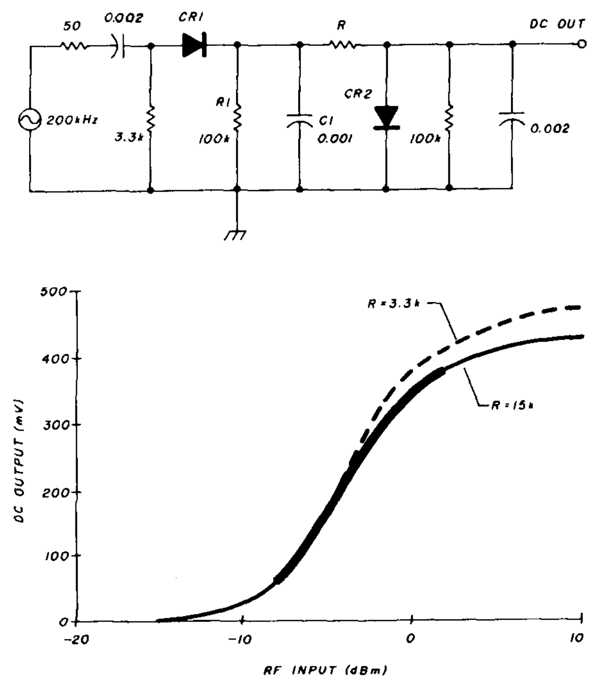


fig. 3. Effect of a clamping diode CR2 on detector characteristic.

amplifier

Each amplifier stage has been designed for a gain of exactly 10 dB over practically the whole range of intermediate frequencies used in Amateur Radio equipment, extending from the old 50-kHz "Q-fiver" to the more modern 9- and 10-MHz transceiver filters. Further requirements were a low output impedance (about 50 ohms) to avoid loading by the detector with its varying impedance, and a dynamic range with a few dBs to spare before the transistor saturates. This, as well as the bandwidth and stability, has mainly been obtained by applying heavy negative feedback.

With only 100 pF across the emitter resistor of each amplifier, the bandwidth is about 2 MHz at the −0.5 dB points. However, by adding extra capacitance the bandwidth can easily be increased to 14 MHz without deteriorating the flat frequency response. This brings

table 1. Final test results.

frequency range:	50 kHz to 14 MHz (−1 dB)
RF input:	−60 dBm to 0 dBm (50 ohms), or 0.22 mV to 0.22 V (500 ohms)
DC output:	0 to 120 mV (oscilloscope sensitivity of 20 mV/division at 10 dB)
maximum error:	1.5 dB
power supply requirements:	120 volts/100 mA

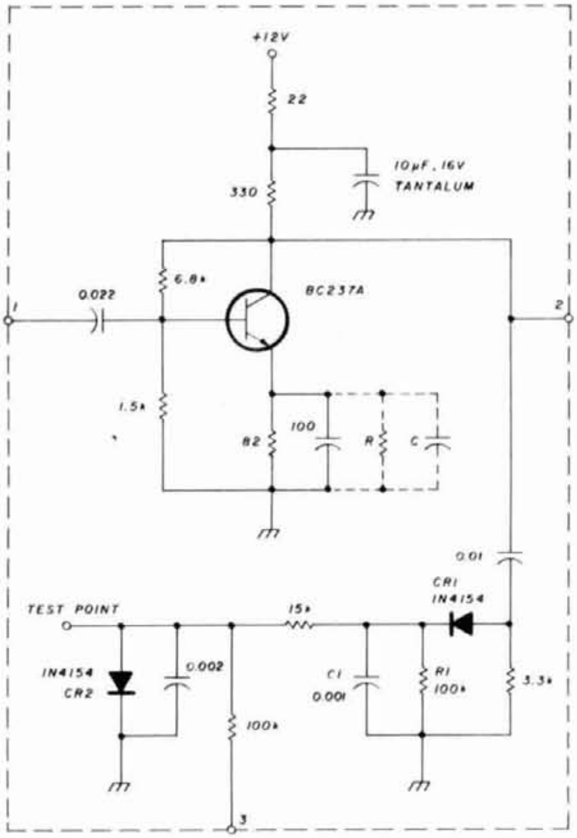
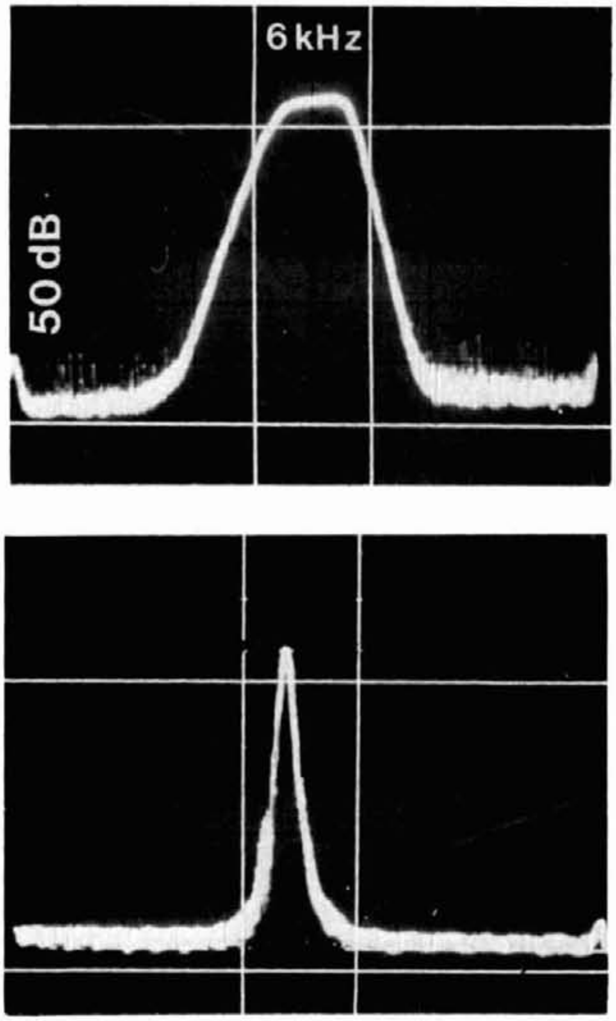


fig. 4. Amplifier/detector stage. Resistor R may be necessary only for correcting the amplifier gain; capacitor C may vary between 50 and 200 pF and has to be selected for optimum bandwidth. (See text.)



Using the logarithmic detector for sweeping an IF amplifier. 352-kHz IF bandpass crystal filter with continuously variable bandwidth in WWII German receiver (Mw.E.C.). Top: at maximum bandwidth (5 kHz); bottom: at minimum bandwidth (130 Hz) (sweep rate 5 Hz).

the detector perfectly in line with the compact IF sweep generator published last month in *ham radio*.[2]

Only readily available components were used. The BC237A is a rather popular audio transistor (at least here in Europe), and the only reason why the 1N4154 was chosen was that, at the time, it was the least expensive diode available in the local parts shop. A perhaps more common 1N914 or 1N4148 would probably work just as well. Normal 5 percent resistors were used (note that 5 percent resistance means 0.5 dB tolerance), yet only a slight correction was necessary to get the voltage gain of each stage at exactly 3.16 times (10dB).

The input impedance of the logarithmic detector is about 500 ohms. In case a 50-ohm input impedance is desired, merely connect a 120-ohm and a 100-ohm resistor in parallel with the RF input plug.

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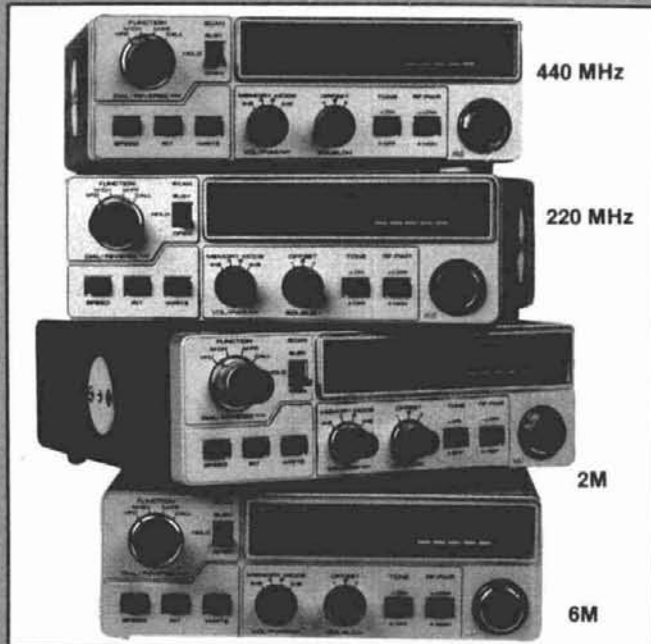

Well . . . they might not last forever. However, there are certainly many older model KDKs out there in 'Ham Radio-land' just chuggin away. Every day calls come from all over asking for information and advice on care and feeding of an FM-144sx or a '2015 and there are even a few older than that but some of them seem to be in disguise. That's a tribute to the folks who design and make the KDK. They care about building a radio to last longer because their name and their pride are on the front of each one. BUT . . . What we are really getting to is we would really like for all you folks who have known and loved your KDK's all these years to go and update yourselves by purchasing a newer KDK, one like, say, the FM-2033 or maybe an FM-7033 UHF. That way you can start your own collection of heirloom KDK radios. Right there in your own hometown. Take a look at the chart of available models and visit your nearest KDK dealer and check them out. We think you will drive home with one.

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MEMORY SCANNING	Memories may be scanned A(1-5), B(6-10), A+B(1-10) or A×B(1-5)			
BAND SCANNING	Programmable band scan between values loaded into memories 5 and 10, step size set in INIT module.			
FREQUENCY RANGE	142.000-149.995 MHZ	220-224.995 MHZ	440-449.975 MHZ	50.00-53.995 MHZ
OUTPUT POWER HI/LO	25/2.5 Watts	25/2.5 Watts	10/2 Watts	10/2 Watts
REPEATER OFFSET	600 kHZ UP or Down	1.6 MHZ UP or Down	5 MHZ UP or Down	600 kHZ UP or Down
SUB AUDIBLE TONE	103.5 @ 500 Hz Dev	103.5 @ 500 Hz Dev	Dipswitch Select	103.5 @ 500 Hz
SENSITIVITY	0.2 uV @ 12dB SINAD	0.35 uV @ 12 dB SINAD	0.4 dB @ 12 dB SINAD	0.2 uV @ 12 dB SINAD
BANDWIDTH	±5 kHZ @ −6 dB	±5 kHZ @ −6 dB	±5 kHZ @ −6 dB	±5 kHZ @ −6 dB
SELECTIVITY	±12.5 kHZ @ −60 dB	±12.5 kHZ @ −60 dB	±12.5 kHZ @ −60 dB	±12.5 kHZ @ −60 dB

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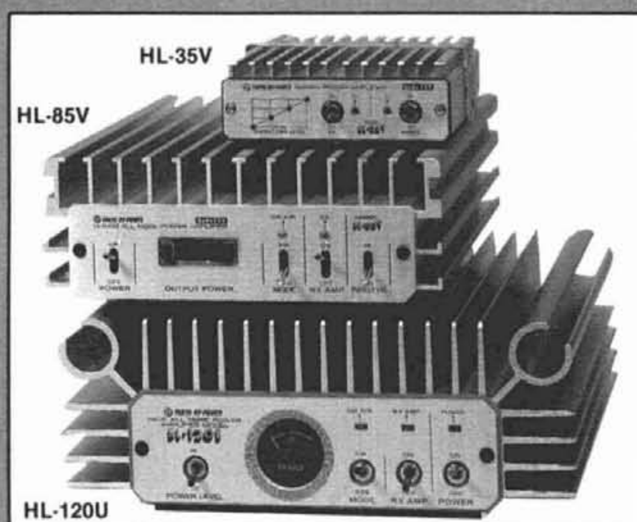

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Input (Watts)	.25-5	.25-5	.25-5	10-14	3-14	3-14	20-30	.1-4	1-4	8-14	8-14
Output (Watts)	2.5-30	2.5-30	2.5-30	70-90	90-110	140-160	140-160	18-22	25-30	45-60	90-110
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109	121	133	145	157	169	181	193	205	217	229	241	253	265	277	289	301	313	325	337	349
110	122	134	146	158	170	182	194	206	218	230	242	254	266	278	290	302	314	326	338	350
111	123	135	147	159	171	183	195	207	219	231	243	255	267	279	291	303	315	327	339	
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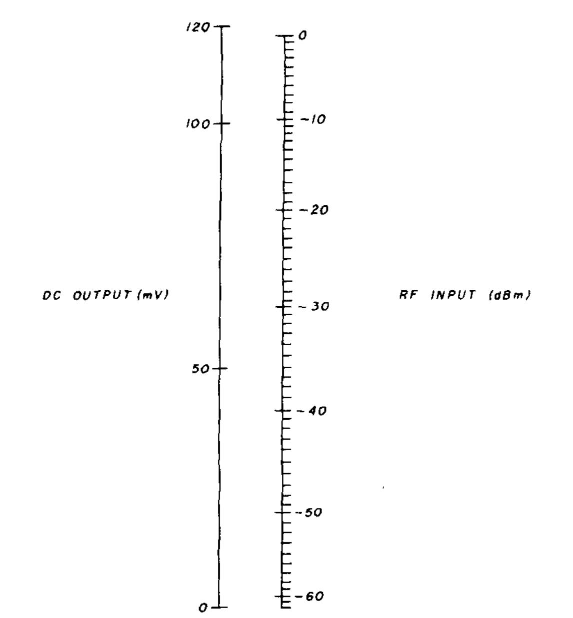

fig. 5. DC output voltage as function of RF input level.

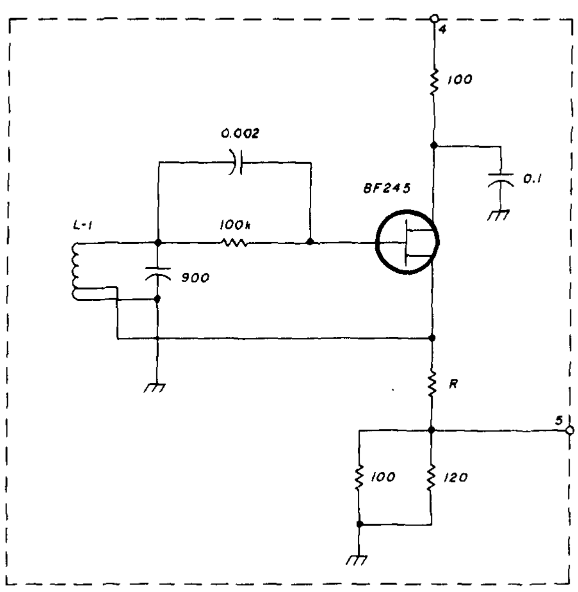

fig. 6. Calibrator. R is approximately 50 ohms, to be selected to obtain a calibrator output of 0.22 volts RMS with 500 ohms load. L1 has 80 + 6 turns on Amidon T-3-50.

The ripple residue on the DC output voltage is imperceptibly small. Only for RF input signals at frequencies lower than a few hundred kHz, the picture lines on the scope tend to become a bit woolly. The LP filter, consisting of an 88-mH coil and two 900-pF capacitors, also removes that last remainder of RF. Its influence begins around 20 kHz, far beyond the point at which it could limit the transient response. At 28 kHz the ripple is already suppressed by 20 dB. In case the detector is never used below, say 300 kHz, the coil and two capacitors could be omitted, leaving the detector without any coil at all.

trimming procedure

This consists of applying an RF signal of about 1 volt to the input, thereby saturating all detector stages. The signal frequency should be somewhere between 100 kHz and 1 MHz. Using a high-impedance voltmeter, measure the DC voltage at each detector test point and see that all are equal (**fig. 4**). If not, increase a possibly low voltage be selecting resistor R *in parallel* with the 82-ohm emitter resistor of the corresponding amplifier.

To achieve the full 14-MHz bandwidth, apply a 10-MHz signal, saturating all detectors again. Increase the possibly low test-point voltages this time by paralleling an extra capacitor across the emitter resistor of the deficient amplifier. **Figure 5** shows how the end result looks after applying the above procedure. The regularity of the dB scale divisions is well acceptable, as shown, with only a slight compression at the top and bottom end. This effect is difficult to avoid; it is caused by the (only partly compensated) first and last detectors lacking the correcting overlap of a neighbor.

calibrator

The logarithmic detector works satisfactorily, is simple and inexpensive to construct, and requires no sophisticated parts or test equipment. If this seems to be almost too good to be true and you're wondering, "where's the catch?" you're right. There is a "catch," and it's in the CR2 diodes.

The textbooks state that the voltage drop across a silicon diode junction decreases by about 2 to 2.5 millivolts for every degree centigrade rise in temperature. Here there are up to six of them, *all adding up*. Although the effect is eventually reduced by voltage division, it still works out to a few millivolts on the end result.

This explains why, on a really chilly day, one may find that the whole dB scale has stretched somewhat and the vertical sensitivity of the scope has to be reduced by 5 or 10 mV to restore the calibration of 10 dB per division. This minor inconvenience (incidently, it is the only "warming-up" effect noticeable) does not justify spoiling the simplicity of the design by the addition of extra compensation circuitry.

Nevertheless, those who would feel more bothered by possible level inaccuracy than by the discomfort of an under-cooled Amateur station, may wish to

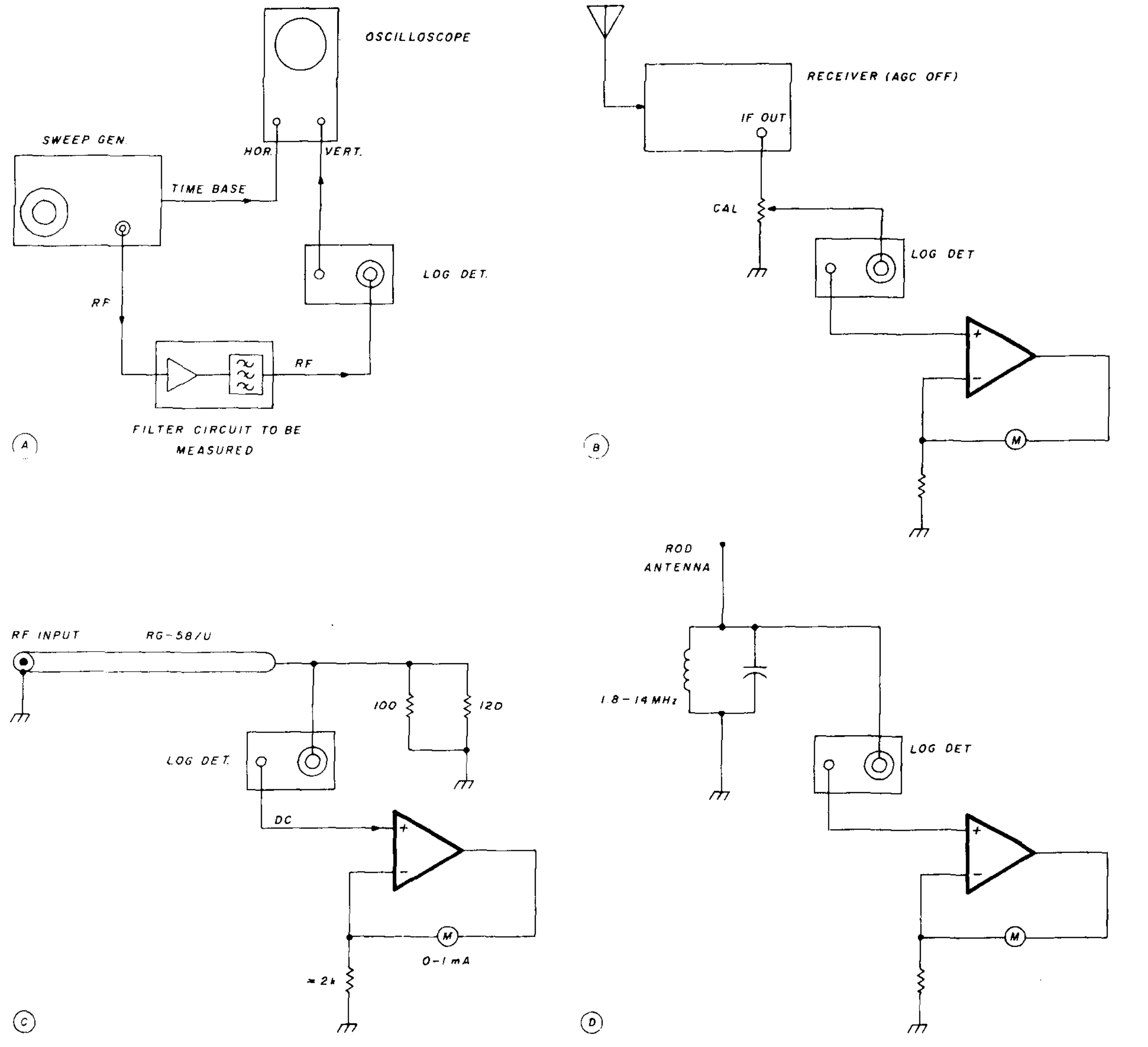

fig. 7. Some applications for a logarithmic detector: (A) Measuring frequency response of an RF filter; (B) Reliable "S" meter, S1 to S9 + 6dB, (C) Single range RF microwattmeter, 2 nanowatts (at 3 percent FSD) to 1 milliwatt (at 100 percent FSD); (D) 60 dB field-strength indicator.

incorporate a built-in 0-dBm calibrator (**fig. 6**). Once the 0-dBm level is set at the correct height of six divisions on the scope screen, the other decades fall into place by themselves. The device consists of a sine-wave oscillator that provides a 500 kHz constant amplitude source of energy. Calibration is not difficult because the oscilloscope itself could be used for the initial setting of the 0-dBm calibrator output voltage. Just remember that 0-dBm into 50 ohms corresponds to 0.62 volt peak-to-peak (0.22 volt RMS).

applications

The application of the logarithmic detector is not limited to sweeping filters only. As some examples in **fig. 7** show, it could be the backbone for an RF microwatt meter with a linear dB scale, or the development of a truly reliable S-meter. Adding a simple tuned circuit results in a deluxe field-strength meter for the HF bands down to 20 meters.

references

1. R. Ferranti, WA6NCX/1, "Design Notes on a Panoramic Adapter," *ham radio*, February, 1983, page 26.
2. Hans Evers, PA0CX, "Compact IF Sweep Generator," *ham radio*, June, page 35.

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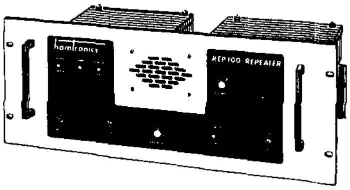

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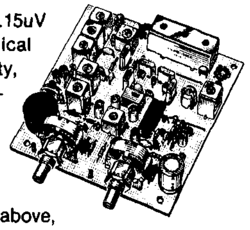

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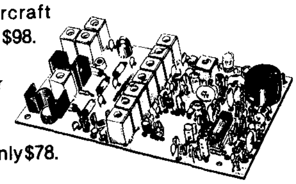

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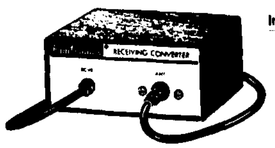

Antenna Input Range	Receiver Output
28-32	144-148
50-52	28-30
50-54	144-148
144-146	28-30
145-147	28-30
144-144.4	27-27.4
146-148	28-30
144-148	50-54
220-222	28-30
220-224	144-148
222-226	144-148
220-224	50-54
222-224	28-30
432-434	28-30
435-437	28-30
432-436	144-148
432-436	50-54
439.25	61.25

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Exciter Input Range	Antenna Output
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28-29	145-146
28-30	50-52
27-27.4	144-144.4
28-30	220-222*
50-54	220-224
144-146	50-52
50-54	144-148
144-146	28-30

For UHF, Model XV4 Kit $99 Wired $169

Exciter Input Range	Antenna Output
28-30	432-434
28-30	435-437
50-54	432-436
61.25	439.25
144-148	432-436*

*Add $20 for 2M input

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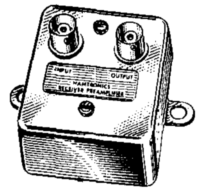

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- High Gain: 18 to 28 dB, Depending on Freq.
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MODEL	TUNES RANGE	PRICE
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LNG-50	46-56 MHz	$49
LNG-144	137-150 MHz	$49
LNG-160	150-172 MHz	$49
LNG-220	210-230 MHz	$49
LNG-432	400-470 MHz	$49
LNG-800	800-960 MHz	$49

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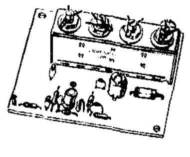

Model	Tuning Range	Price
HRA-144	143-150 MHz	$49
HRA-220	213-233 MHz	$49
HRA-432	420-450 MHz	$59
HRA-( )	150-174 MHz	$54
HRA-( )	450-470 MHz	$64

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VHF/UHF WORLD

Joe Reisert W1JR

propagation update

When it comes to discovering new propagation modes and extending DX records, the VHF/UHF/SHF frequencies represent Amateur Radio's latest frontier. Judging from correspondence and on-the-air discussions, there's a pioneering spirit — and a great curiosity about the unknown — among hams active on these bands.

Because reader response to last July's column[1] on VHF/UHF propagation was so encouraging, I've dedicated this month's column to expanding and updating the material presented in that issue.

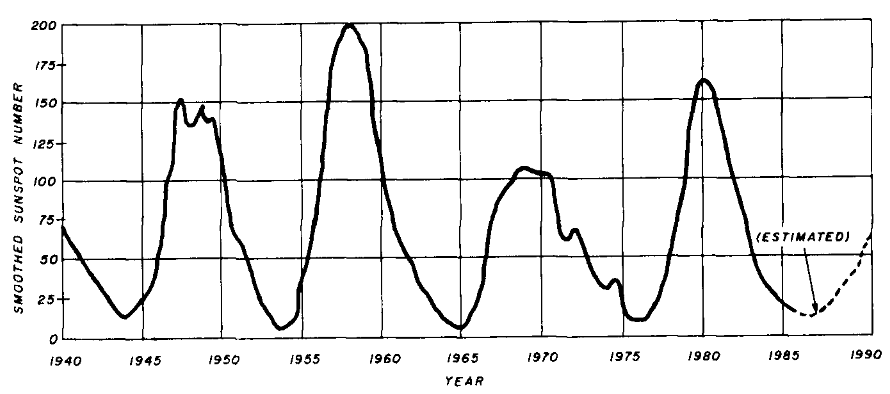

fig. 1. This graph shows the variation in the smoothed sunspot numbers over the last few solar cycles.

VHF/UHF/SHF frequency bands

It wasn't too many years ago that all frequencies above 40 GHz were open to Radio Amateurs. However, as research in millimeter waves increased, commercial and government interests forced subdivision of the frequencies between 40 and 300 GHz. From our point of view, this measure created new bands to explore as separate entities.

Table 1 shows all the major VHF/UHF/SHF bands available to Radio Amateurs. WARC also subdivided these frequency assignments by IARU regions. Generally speaking, Region 1 includes most of Africa, Europe, and the Soviet Union. North and South America as well as Hawaii are in Region 2, and the Southern portions of Asia and the Oceania nations are in Region 3.

In recent years there has been a tendency to designate all bands in meters rather than by frequency in MHz. I've therefore listed the metric band designations next to each frequency assignment on the table. Note that in some cases a band may or may not be available in some regions. For instance, although UK Amateurs have a 4-meter band, they have no frequencies available between 2 meters and 70 cm. Region 2, on the other hand, has a 6-meter band and a 135-cm band. Where known, I've listed differences in frequency assignments. Normally speaking, the differences are not significant unless you are operating outside your region — such as in EME!

VHF/UHF/SHF DX records

By the time last July's *ham radio* appeared, many of the VHF/UHF/SHF DX records listed in my column, prepared two months earlier, had been broken. To me, DX records — especially in the world above 50 MHz — are a major driving force in the progress of communications technology. At a glance, they reveal not only the development of the state of the art, but also suggest the possibilities and challenges available.

The VHF/UHF/SHF DX records claimed worldwide and given in last year's July column have been, with the exception of those claimed for EME, updated and listed in **table 2. Table 3** shows EME record claims. In recent years many of the records once held in Region 2 have shifted to other regions because of special propagation modes such as transequatorial (TE) or tropo ducting favoring these other regions. This has tended to discourage DXing in those areas in which only more conventional propagation modes such as aurora and meteor scatter are available. So I'll try a new approach (one already used, by recordkeepers in Region 1), listing, in **table 4**, only North American DX claims. This table lists DX records by propagation modes for all VHF/UHF/SHF bands on which Amateur comunications records have been claimed.

I hope that this type of listing will inspire increased effort and exploration of the various propagation modes, especially here in North America. The data listed in **table 4** was difficult to table 1. Major VHF/UHF/SHF worldwide Amateur Radio frequency assignments.

band	frequency range	notes
6 meters	50-54 MHz	CW only between 50.0-50.1 in USA. Only a few assignments in Region 1.
4 meters	70.025-70.5 MHz	Primarily United Kingdom.
2 meters	144-148 MHz	CW only between 144.0-144.1. Except in Region 2, most other countries have only 144-146 MHz.
135 cm	220-225 MHz	Region 2 only.
70 cm	420-450 MHz	Region 2, Canada only 430-450. Most of the rest of world has only 430-440 MHz.
33 cm	902-928 MHz	Not yet available in USA except for those with FCC experimental licenses. Canada has same but on A3/F3 only.
23 cm	1215-1300 MHz	1215-1240 still available in Canada, but recently withdrawn in USA. Some countries in Region 1 do not have the full assignment. Others have power or EIRP restrictions.
13 cm	2300-2450 MHz	2310-2390 was removed for USA on November 6, 1984. Many Europeans cannot operate below 2320. Japan has only 2400-2450.
9 cm	3300-3500 MHz	Some area restrictions apply. UK has 3400-3475.
6 cm	5650-5925 MHz	Some area restrictions apply. UK has 5650-5850.
3 cm	10.0-10.5 GHz	
12 mm	24-24.25 GHz	24-24.05 in West Germany
6 mm	47-50 GHz	47-47.2 in West Germany, 48-50 in USA
4 mm	71-76 GHz	75.5-76 in West Germany
2 mm	142-170 GHz	165-170 GHz in USA, 142-144 GHz in West Germany.
12 μm	240-250 GHz	248-250 in West Germany.
10 μm	300 GHz and above	No restrictions in USA

table 2. Claimed VHF/UHF/SHF terrestrial DX records (worldwide). EME records are shown in *table 3*.

band	record holders	date	mode	DX miles	DX (km)
6 meters	(see Note 1)				
4 meters	GW4ASR/P-5B4CY	June 7, 1981	E_s	2153	(3465)
2 meters	I4EAT-ZS3B	March 30, 1979	TE	4884	(7860)
135 cm	KP4EOR-LU7DJZ	March 9, 1983	TE	3670	(5906)
70 cm	KD6R-KH6IAA/P	July 28, 1980	ducting	2550	(4103)
23 cm	KH6HME-N6CA	June 24, 1984	ducting	2472	(3977)
13 cm	VK5QR-VK6WG/P	February 17, 1978	ducting	1170	(1883)
9 cm	G3LQR-SM6HYG	July 11, 1983	ducting	576	(927)
6 cm	G3ZEZ-SM6HYG	July 12, 1983	ducting	610	(981)
3 cm	I0SNY/EA9-I0YLI/IE9	July 8, 1983	ducting	1032	(1660)
12 mm	I3SOY/3,IW3EHQ/3-I4BER/6, I4CHY/6	April 25, 1984	LOS	180	(289)
6 mm	DJ1CR-DL3ER/P	June 11, 1984	LOS	9.3	(15)
10 μm	WA2GFP/2-K2KXS/2	June 10, 1983	LOS	0.2	(0.3)

Note 1. 6 meters has been omitted from this listing because long-path QSOs (those exceeding 12,440 miles or 20,016 km) have been reported during solar cycles 19 and 21.

obtain in this initial phase; I'm not aware of any other attempt to compile and list it all in a single source. I've been filing much of this type of information for over 15 years. Lately, dozens of letters had to be written, and it took the effort of many others to bring this information together, especially on the various propagation modes. In this first attempt, some of the listings may not really represent the best or most recently attained North American record. Because information may, in some cases, be simply unavailable, some propagation modes may not be listed.

I'll be glad to act as a coordinator for all North American and worldwide VHF/UHF/SHF DX claims and will continue to compile and update these records and make them available to ham radio *and other publications.* If you think that you or someone else holds a better DX record than any of those shown in these tables, I'll be glad to consider your claim. For record keeping purposes, I've prepared a comprehensive form to be filled out when claiming a record. Just send me an SASE, appropriately marked, and I'll send you a copy.

propagation breakdown

In last year's propagation column I listed over 20 distinctly different modes of VHF/UHF/SHF propagation. I also made several propagation predictions that came to pass soon after the issue appeared. This experience only reinforced my feeling that the VHF/UHF/SHF frequencies are a great place for experimentation. In light of other information now available, new material should be added to the content of last year's column.

F2 propagation. There's no doubt that solar cycle 21 peaked higher than expected, but it is now approaching minimum. **Figure 1** summarizes sunspot data for the last few cycles. While it may be easy to conclude that the sunspots will bottom out in 1986-1987, they will increase again and probably peak in 1990. However, it is my belief that cycle 22 won't equal the high peak of cycle 21.

I believe this because there seems to be more than enough evidence to link high sunspot activity to the lineup of the planets in certain special arrangements. The late John Nelson of RCA was a strong proponent of this theory and explained it well.[2] The planets line up best about every 175 or so years, with the best alignment occurring in 1984. I doubt that many of us will be around in the year 2159!

Nelson also pointed out that the actual sunspot activity peak occurs when certain major planets are at 90

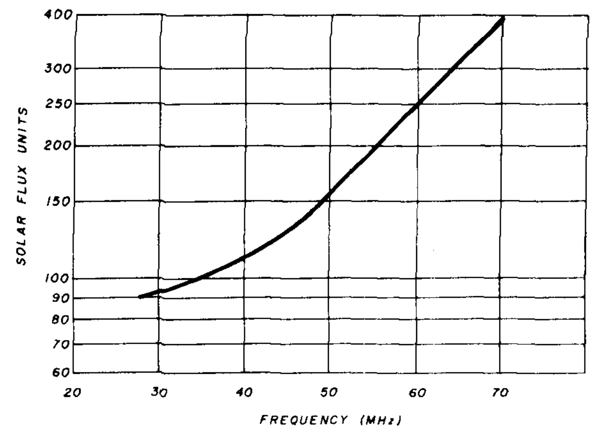

fig. 2. This graph shows the estimated minimum solar flux units necessary for propagation of frequencies from 28-70 MHz per information generated by G8KG.[3]

table 3. Worldwide claimed EME DX records. (See *table 4* for North American EME records.)

band	record holders	date	DX miles	(km)
6 meters	K6MYC-K8MMM	July 24, 1984	2127	(3422)
2 meters	K6MYC/KH6-ZS6ALE	February 18, 1983	12088	(19450)
135 cm	K1WHS-KH6BFZ	November 17, 1983	5058	(8139)
70 cm	F9FT-ZL3AAD	April 18, 1980	11679	(18793)
23 cm	PA0SSB-ZL3AAD	June 13, 1983	11595	(18657)
13 cm	PA0SSB-W6YFK	April 5, 1981	5491	(8836)
9 cm and above	none reported			

degrees to each other with respect to the sun. Furthermore, the minor planets (in particular Mercury and Venus) introduce secondary peaks on the main curve. This probably explains why the F2 activity seemed to peak in 1979, then disappeared and finally came back in 1981 at a slightly diminished level.

Much was learned about F2 on 6 meters during cycle 21. For instance, based on tests between G3SSD and VE1AVX, F. M. Smith, G8KG, has speculated that the 10.7 cm (2800 MHz) solar flux must reach at least 160 for the MUF to reach 50 MHz.[3] Values for other MUFs with equivalent sunspot numbers are shown in **fig. 2**. The 10.7 cm solar flux as measured at Ottawa (the reference station for NOAA) is broadcast at 18 minutes after each hour on WWV and is available any time by calling 303-497-3235.

I have used MINIMUF[4] to predict openings over paths as long as 6000 miles (9654 km) with reasonable accuracy. Solar flux can be determined by using the following approximate equation.

$$\text{solar flux} = 63.7 + 0.73R + 0.0009R^2 \qquad (1)$$

where R is the daily sunspot number.

With this knowledge, improved equipment, and an increase in countries that should have 6-meter privileges by 1990, we should all have something to look forward to during the next solar cycle.

E_S (mid-latitude sporadic-E). Sporadic-E propagation is one of the main propagation modes used by 6-meter operators. In the mid-northern latitudes it usually begins in May and ends in early August. A secondary but weaker peak may come during December and early January.

Ernest Smith and Edwin Davis have been studying E_S propagation for many years.[5] They speculate that E_S propagation is caused when the upper atmosphere, ionized by solar radiation, is subjected to a wind shear. They note that the effects are masked in some parts of the world by precipitation of charged particles at high latitudes and unstable plasmas in the charged particle stream at the magnetic equator. They also point out that during the E_S season, propagation will occur about 1 percent of the time in the southern USA and will drop to 0.3-0.4 percent in the northern USA and southern Canada. Contrast this with a probability of 5-6 percent for the Japanese!

The early 1984 E_S season started off with a bang in early May. Then came a 6-meter opening in mid-May that possibly involved E_S and TE linkup and gave many east coast USA stations their first contacts with Argentina and Chile. Several stations checked 10 meters during this opening, but no signals were heard!

W6JKV made a trip to Nuuk, Greenland in mid-June, 1984. He made about 250 contacts to the USA in widely scattered directions and completed five QSOs with the UK. But by late June openings seemed to come to a screeching halt. One narrow-path W1/W2 to GJ3YHU opening did occur on June 30, but it did not extend into the UK proper (yes, I know there were UK stations who heard GJ3YHU working the USA, but they couldn't hear the USA stations). HB9QQ reported that many 2-meter contacts were made over a wide area of Europe during this same opening.

E_S 6-meter openings returned in late July. As predicted in last year's column, there were some scattered 2-meter openings in late July, but they were gone by early August and few were noted in the December time frame.

There is speculation that a lightning storm whose top reaches an altitude

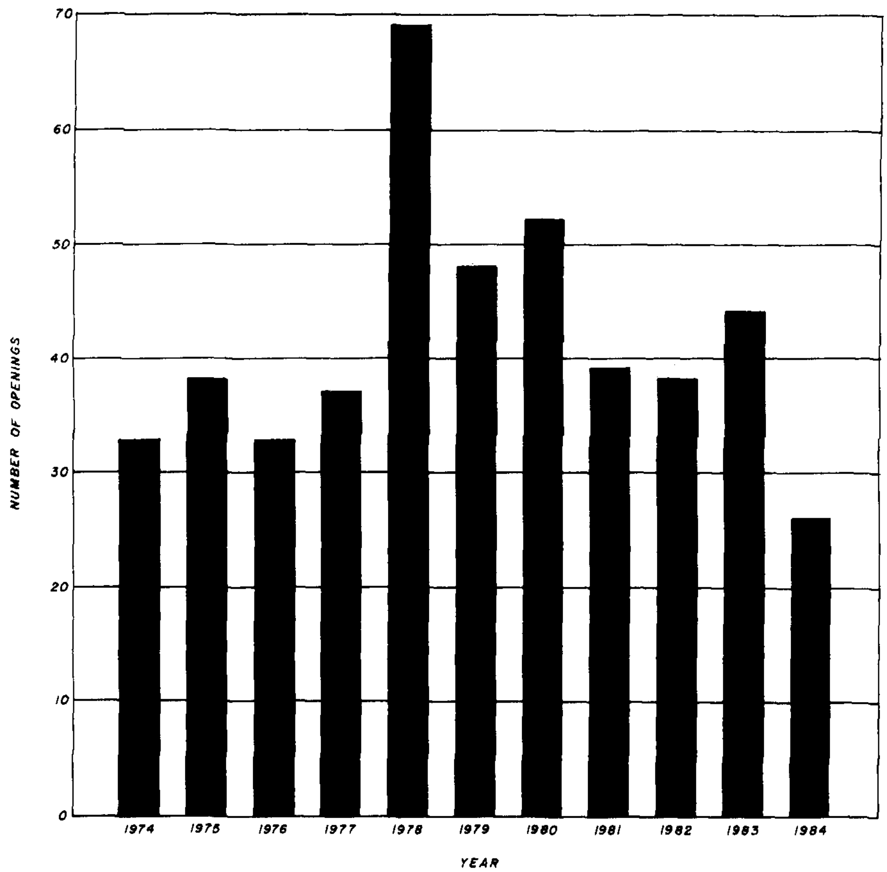

fig. 3. Plot of the observed E_s openings noted in the last 10 years in the UK by Ron Ham.[8]

of 50-60,000 feet (18,288 meters) near the center or at one end of the path may cause a 2-meter opening.[6,7] Such an opening did appear during at least one 2-meter opening in 1984, with a storm (recorded on FAA weather maps) near one end of the path. Jim Stewart, WA4MVI, has seen storm tops as high 72,000 feet (21,946 meters) indicated on the same weather maps!

A mid-December 2-meter opening also occurred between El Paso, Texas, and VE6/VE7. WA4MVI feels that this opening was caused by a special horizontal wind shear force, not as high as the summer ones noted above, but such as typically occur in December in the regions above the Rocky Mountains. FAA weather maps generated at the time of this opening did show an upper-air wind shear at the approximate mid-point of that path!

E_S propagation for the 1984 season as a whole was significantly down from previous years, especially during the winter peak season. Likewise, 6-meter double-hop openings were few in number, especially to the Caribbean. Some Amateurs have speculated that E_S propagation is more intense during low sunspot years, but I can't find any data to substantiate this.

Recently, Ron Ham released his summary of the E_S openings he observed in the UK for 1984 and the 10 years before.[8] I have plotted his observations in **fig. 3**. This data clearly shows the increase in numbers of E_S openings during the high sunspot years.

WA4MVI indicates that the taller thunderstorms, which usually influence the E_S propagation, are more prevalent in years when sunspot activity is high! Therefore, for high E_S activity, I'd say that we may have to wait until the sunspots increase again.

In last year's column I noted that double-hop 2-meter openings have been reported in other parts of the world but not in the USA. I stand corrected; there *have* been some here — of special interest were the ones on 12 July 1982. During this fantastic opening VE1SPI was operational from St. Paul Island, a separate DXCC country in the St. Lawrence River. VE1SPI made about 250 2-meter contacts. Of note is that the operator, VE1ASJ, reported that he could clearly surmise double hop: for example, first only W8's and WØ's were heard, then only W3's and W9's, etc.

VE1UT in New Brunswick noted a similar pattern during this opening. Although I may not have located the best DX to occur during that opening (write to me if you can top this), the longest documented 2-meter contact, listed in **table 4**, was clearly a double-hop QSO. With a little bit of luck, we may someday see coast-to-coast 2-meter openings!

Sporadic-E propagation is surely bad news to TV and FM stations. In Europe the lower-frequency TV stations are slowly being replaced by VHF assignments and in the UK all of the low-band TV channels are now silent. This will make it more difficult to observe long DX openings by monitoring European video carriers as we did during the last solar cycles.[1]

However, there are now more 6-meter beacons worldwide with recent additions including one in the UK (GB3SIX) and another in Greenland (callsign unknown). They complement the ZB2BL, FY7THF, KH6EQI and KG6JIH beacons, most of which operate between 50.0-50.1 MHz.

The UK has now licensed over 100 Amateurs to operate on 6 meters outside of the TV hours on the continent. Norway has also licensed at least 25 Amateurs with the same provisions. The lower TV channels in the UK are all gone now and the Norwegian TV assignments in this spectrum are scheduled for shutdown by 1986. Hence, the chances of European DX

on 6 meters are improving, and more countries are looking at Amateur assignments.

Just as this manuscript was going to press, I received a note that Sid Lieberman, WA2FXB, has developed a method to predict possible E_s openings using the K indices from WWV.[9] Perhaps he'll be able to shed some light on the prediction of E_s openings. E_s propagation is still widely studied and we may someday be able to predict it with good accuracy.

T.E. scatter. Trans-equatorial scatter has not been too common lately except on 6 meters in the equinoctial time periods. Hopefully more work can be done when cycle 22 begins and the necessary solar activity reappears. Likewise, equatorial FAI (field aligned irregularities), ionospheric scatter, and midlatitude FAI propagation are lower in these low sunspot years but they will return! **Table 4** shows that within the USA there has been some real 2-meter DX via midlatitude FAI.

Aurora. This mode of propagation is also heavily dependent on solar activity, and in particular, solar flares. I've been told that the incidence of auroral propagation increases with solar activity, but that the greatest number of auroras appears when the sunspots are declining.

This is why I keep careful notes in my logs on known auroras. Sure enough, there's a definite trend. **Figure 4** shows a plot of the number of auroral openings I've observed over the last eight to ten years. Note the increase in auroral openings as the sunspots decreased in 1982.

G2FKZ has plotted auroras since 1932.[10] He notes that the highest incidence of aurora on a month-by-month basis occurs in April, September, and October, in that order. December, January, February, and November are significantly lower in activity, with only about one-fourth the occurrences of April, September, and October. (See **fig. 5**).

I've been told that Canadian Research Labs (CRL) has done a lot of

table 4. North American claimed VHF/UHF/SHF DX records, listed alphabetically by the most common modes of propagation. The (tropo) ducting records are for paths that are mostly over water. (See text for how these records were determined and how you can challenge or add to those records shown.)

band	record holders	date	mode	DX miles	DX (km)
2 meters	K2RTH-W5WAX	March 8, 1970	aurora	1221	(1964)
	VE1UT-VK5MC	April 7, 1984	EME	10985	(17,676)
	K0UDZ-VE1UT	July 12, 1982	E_s	1832	(2947)
	W5HUQ/4-W5UN	July 25, 1983	FAI	1229	(1977)
	K1ABR-W5ORH	August 12, 1968	MS	1469	(2364)
	KP4EOR-LU5DJZ	February 12, 1978	TE	3933	(6328)
	K1RJH-K5WXZ	October 8, 1968	tropo	1465	(2358)
	KH6GRU-WA6JRA	July 29, 1973	ducting	2591	(4169)
135 cm	W1FC/1-W0VB	June 13, 1982	aurora	1039	(1672)
	K1WHS-KH6BFZ	November 17, 1983	EME	5058	(8139)
	WB4NMA-W5FF	August 12, 1983	MS	1273	(2048)
	KP4EOR-LU7DJZ	March 9, 1983	TE	3670	(5906)
	VE3EMS-WB5LUA	September 28, 1982	tropo	1181	(1901)
	KH6UK-W6NLZ	June 22, 1959	ducting	2540	(4087)
70 cm	K1PXE-W0RAP	July 13, 1982	aurora	957	(1540)
	K2UYH-VK6ZT	January 29, 1983	EME	11567	(17,612)
	W2AZL-W0LER	August 12, 1972	MS	1020	(1641)
	WA2LTM-WB5LUA	September 10, 1979	tropo	1310	(2108)
	KD6R-KH6IAA/P	July 28, 1980	ducting	2550	(4103)
23 cm	K2UYH-VK5MC	December 6, 1981	EME	10562	(16,995)
	WA4OFS-W5VY	March 25, 1985	tropo	1046	(1683)
	KH6HME-N6CA	June 24, 1984	ducting	2472	(3977)
13 cm	PA0SSB-W6YFK	April 5, 1981	EME	5491	(8836)
	W4HHK-W8YIO	July 28, 1983	tropo	583	(938)
9 cm	K6HIJ/6-W6IFE/6	June 18, 1970	LOS	214	(344)
6 cm	K5PJR-K5FUD	September 20, 1977	tropo	267	(430)
3 cm	W7JIP/7-W7LHL/7	July 31,1960	LOS	265	(426)
	WA4GHK/4-WD4NGG	August 7, 1984	ducting	297	(478)
12 mm	W2SZ/1-W2JVF/2	September 8, 1984	LOS	53	(86)
6 mm	W2SZ/1-WA2AAU/1	June 13, 1982	LOS	0.3	(0.5)
10 μm and up	WA2GFP/2-K2KXS/2	June 10, 1983	LOS	0.2	(0.3)

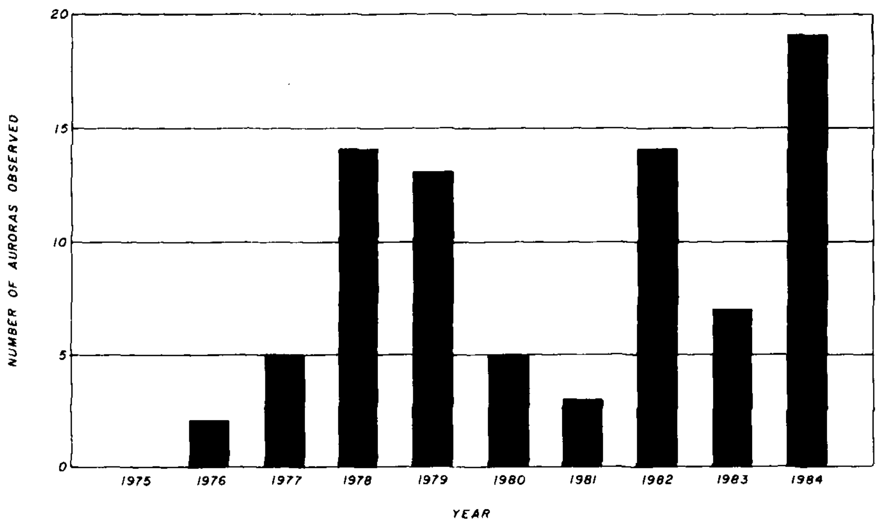

fig. 4. Plot of the number of observed auroral openings at W1JR for the last 10 years.

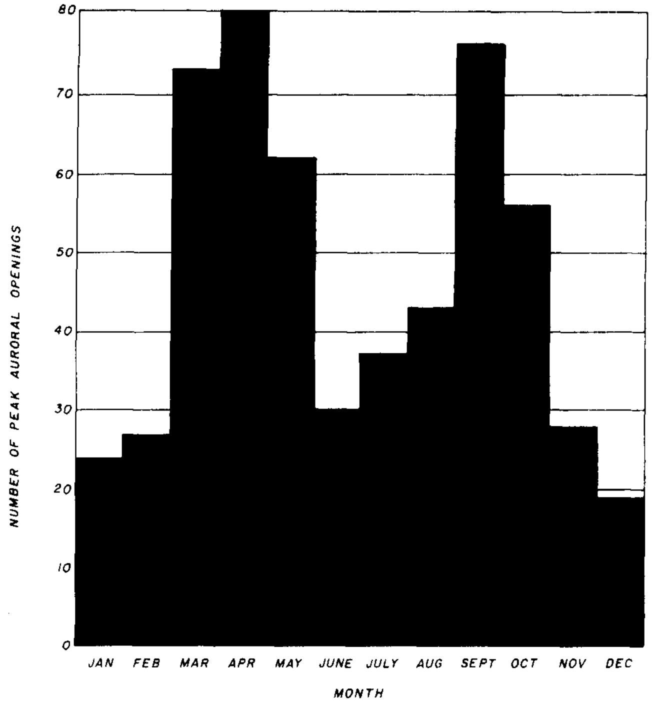

fig. 5. Peak auroral openings by months since 1932 from data by G2FKZ.[10]

aurora research, but I haven't yet received any of their papers. CRL has noted that the auroral oval stays further north during low sunspot years and extends southward during years of high sunspot activity.[1] This would explain why some of the southern portions of the United States, which rarely see auroral propagation, were treated to some good openings during the peak of cycle 21. Radio aurora was also the subject of a recent *QST* article.[11]

In summary, auroras may decrease in frequency during the next few years but they will not disappear entirely. Look for a WWV *K* index of 5 or greater for an early indication of aurora.[1] If you plot the WWV *K* indices, you'll find that auroras often return 28 or so days later. NOAA's weekly report is also valuable in summarizing past data and predicting future sunspot, *A* and *K* indicies.[12]

Meteor scatter. This is "the fun mode" that heretofore wasn't thought to have been affected by solar activity.

Some Swedish scientists, however, now report that from their observations, meteor scatter propagation seems to improve during the period of low solar activity.[13]

For instance, meteor counts made by radars in Sweden were higher by a factor of 2 during the sunspot minimum in 1963 than during the maximum in 1956-57. They also found that while the beginning heights of meteor trails varied little from year to year, the terminal heights were 6.84 miles (11 km) higher at sunspot minimum. Hence the meteor showers during the next few years should improve. Couple this with the possibility of a link between Halley's comet (arriving in late 1985) and some of the major meteor showers (such as the Eta Aquarids and the Orionids) and we could see some superior meteor shower performance to offset other sunspot-related propagation modes.

The amount of data available strongly supports the technique for predicting meteor shower peaks described in my June, 1984, column.[14] In fact, this method predicted the 1985 Quadrantids shower peak to within hours of its beginning. But there seems to be some disagreement on the accuracy of using the ecliptic longitudes as shown in **table 2** in that article. Due to slight shifts in the earth's orbit, errors of a few hours will gradually creep into the ecliptic longitude at 0000 UTC as the years go by.

However, the use of the computer program provided in **fig. 1** of the July, 1984, article is thought to be a more accurate method for predicting the peaks. This all may be somewhat academic because most showers last 24 to 48 hours during peak (greater than 25 percent of maximum), so **table 2** should be OK for the next few years.

In the same column, I made a negative comment about packet radio meteor scatter contacts. Since that article appeared, the first documented contacts have taken place on 6 and possibly 2 meters. My remarks were made in a tongue-in-cheek fashion as a joke with one of my packet radio friends, Jeff Moore, KQ1E. Those who know me know that I'm never going to stand in the way of progress . . . but there's something about actually *hearing* and completing a meteor scatter QSO. For some, this means seeing a message appear on a CRT! Go to it. I won't stand in your way!

Meteor scatter communications is one of the most important propagation modes for the VHF/UHFer. More work has to be done, especially on 135 and 70 cm. There are many unused showers available for exploration. The use of the VHF/UHF calling frequencies is a good step toward increasing random contacts. Home computer programs for predicting meteor shower peaks as well as optimum direction and time of day are very powerful tools.

EME. This mode of propagation has really taken off. In 1984, there were reported contacts on 6 and 2 meters as well as on 135, 70, 23, and 13 cm! Techniques and equipment are steadily improving. Low-cost GaAs FETs are now available that will deliver the ultimate in low noise figures required for EME.[15]

Most of the EME action is on 2 meters and 70 cm. Some of the larger 2-meter stations have huge arrays,[16] which allows smaller stations, with a

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single Yagis and moderate power (500 watts output), to routinely make contacts with the larger stations using a rising or setting moon.

Although the 135-cm band has been very much ignored by the EMEers, it's a terrific band for EME. Antenna systems are not as critical and are only 50-75 percent of the size required for 2-meter EME. Because the sky noise is lower, the signals are stronger. All the necessary 135-cm EME components can now be built or purchased.[17] *Warning: this is a band we could lose if we don't start using it properly.*[18]

EME on 70, 23, and 13 cm is maturing rapidly. Over 40 DXCC countries are available on 70 cm on all continents. Twenty DXCC countries from five continents are now active on 23 cm and almost ten countries are on 13 cm. On 23 and 13 cm, the parabolic dish is king. If low-noise GaAs FET preamplifiers are used, echoes can be obtained with as little as 100 watts and a 13-foot (4 meter) parabolic dish.

The stout-hearted and others in search of a real challenge should give EME a try. Still quite an adventure, it's an excellent proving ground for new equipment. I think we'd be at least five years behind in antenna technology today if it weren't for the need for high-gain efficient Yagi antennas required for EME. Now these same antennas are being used to improve performance on other, more conventional, propagation modes.

Weather-related propagation. Watching the weather and trying to predict it was a hobby of mine until I discovered Amateur Radio. This background has served me especially well since I began working the VHF/UHF frequencies.

Over the years I've noticed a strange weather phenomenon, especially in climates that experience temperature changes of greater than 75 degrees F (42 degrees C): *there seems to be more than four distinct seasons.*

According to my "Five-Season Weather Calendar," the weather appears to change on five key pivot calendar dates, 73 days apart. I find that March 1 is a good reference point for determining the first pivot date. The other dates are May 13, July 25, October 6, and December 18.

What I notice is that the weather in any particular area of the country around each pivot date (± 1 week) gives an indication of the weather to be expected during the next 73-day period. For instance, if the weather is generally cold at the end of February through the first week of March, the weather to follow will probably be cool until the next pivot day (May 13). Likewise, in the northern hemisphere, moderate temperatures near the weeks surrounding December 18 portend a milder winter season.

Furthermore, this five-season weather concept seems to be in step with radio propagation. For instance, the E_S season seems to begin around May 13 and is usually almost over by July 25. Could it be that the jet stream moves in approximately 73-day increments? Hurricanes in the United States seem to form in late July and are usually over by early October. Is this concept only a figment of my imagination? Or is it really so?

Tropospheric propagation. There's no doubt that tropospheric propagation, tropospheric ducting, and superrefraction are directly related to the weather patterns. As mentioned in reference 1, long-haul tropo DX seems to come after a slow-moving high-pressure area (greater than 30.27 inches of 1025 millibars on a barometer) is followed by a moist low-pressure system. Recently, VE3CIE wrote an interesting article on tropo propagation as related to meteorology.[19]

The past year has seen some good long tropospheric openings both in North America and Europe. First there was the ducting from California to Hawaii when KH6HME and N6CA finally made the grade on 23 cm. At the time a tropical depression was noted on the southern side of the path off Baja, California. As in the past openings, the signals disappeared a few miles inland at the California end of the path.

Next came the openings between the Canary Islands (EA8) and the United Kingdom in July. This opening was also a function of ducting, since only stations near the coast of southern England and Wales were able to hear the EA8 stations. Signals were strong and relatively small stations (10 watts) were able to make contacts.

Finally came the fantastic opening that extended from New England and New York to Florida during the ARRL September VHF QSO party. This was a classic opening that was clearly a mix of normal tropo and ducting. The barometer was very high — and right off the east coast was the large hurricane Diana! Who says there's no link between hurricanes and good DX?

The salient feature of this opening was the evidence of an elevated duct. The stations located at least 500 feet (150 meters) above sea level were particulary favored. W2SZ/1 and W1XX/2 were over 3000 feet (900 meters) above sea level and they reported that making long-haul contacts was like shooting fish in a barrel. W2SZ/1 operators noticed a distinct haze layer above and below their mountaintop location in the early morning.

WA4MVI, a private pilot, decided to observe the opening from the air. He loaded his 70-cm gear, including a five-element Yagi, into a small plane. He then flew at various elevations over the western tip of South Carolina and into North Carolina to see if there was a duct and, if so, where it was located. At 750 miles (1200 km) from W2SZ/1, he was able to continuously monitor their 70-cm signal strength from approximately ground level to about 14,000 feet (4,267 meters). He found a duct between about 4000 feet (1200 meters) and 10,000 feet (3050 meters). Signals in the duct were typically 20 dB over S9. However, signals abruptly weakened above and below the duct, dropping to almost inaudible at ground level and at 14,000 feet. His temperature-versus-elevation observations showed a more or less constant value within the duct instead of the normal decrease with increasing altitude. He also noted that the wind speed in the duct was very high — typically 40 knots — and that the wind came from the east. However, above and below the duct there was only a moderate 10-knot wind — coming from the *west*!

In mid-December, when such phenomena are rare, another east coast tropospheric duct period was in evidence. Also present, just off shore, was an unwelcome guest — hurricane Lily! (The weather reports said that this was one of the few hurricanes ever seen in that part of the Atlantic Ocean during the month of December.)

And how about the terrific openings during the ARRL VHF contest in September, 1979, when hurricanes David and Frederic were both off the Southeastern coast of the United States? Again, the link between hurricanes and good long-haul VHF/UHF DX seems difficult to dispute!

Openings such as this prompt some hams to remark "Oh, the bands are always open. It's just that we don't have all that mountaintop activity outside of the contests." *This just isn't so*. Most of the VHF/UHF contest dates are planned to coincide with periods known to have good radio propagation. Mountain-toppers are always active, especially during contests, but they usually experience only the normal extended range expected for an elevated QTH. To have an extended opening, you have to have the right ingredients: proper weather *and* location.

In my July, 1984, column I stated that ducts do not extend far inland. This statement applies mainly to the oceans, especially when the land near the coast is hilly or mountainous. The Gulf of Mexico does not fit this description but instead acts more like a large inland body of water surrounded by relatively flat land. As a result, ducting *can* move inland.

This is most noticeable on the path between Texas and Florida, especially between the months of February and May. Just as this column was being completed, I learned of a particularly long DX contact (approximately 1046 miles or 1683 km) on 23 cm, between WA4OFS (St. Cloud, Florida) and W5VY (San Antonio) — see **table 4.** Both stations are very far inland.

The next few years should prove very interesting as the jet stream moves slightly because of lower sunspot counts. Will tropo propagation disappear? I doubt it very much — but it may favor different areas of the country than it does during the high sunspot years.

Lightning scatter. Over the past year I've had many reports from individuals who've used various scatter mechanisms. W7BYF informed me that he made what was undoubtedly a lightning scatter contact when he was W8NAF in Dayton, Ohio. In July of 1958 he worked W8KAY in Akron, Ohio, on 2 meters, with both stations pointing their antennas at a lightning storm center in Ft. Wayne, Indiana. Several other stations also worked W8KAY by the same technique.

To work lightning scatter, set up a schedule for 15-30 minute periods with a distant station. Each station transmits for 1 minute — one on the odd minute and the other on the even minutes. Listen carefully when working extended paths. More often than not, the signals will seem to appear almost out of nowhere. When signals appear, switch over to break-in procedures and enjoy a quick snappy QSO. The better the location and the shorter the distance between stations, the longer the propagation will last.

Aircraft scatter. VHF/UHFers often seem surprised when you mention that they may be using aircraft scatter propagation. However, scatter is often present on 200-400 mile (325-650 km) contacts even though it may not be obvious on the lower VHF bands. On 70 cm and above, aircraft is most often responsible for extended daily contacts. Using aircraft scatter requires some patience, since aircraft may be in the proper location for only a few minutes.

Barium clouds. The jury is still out on whether VHF/UHFers can use these man-made ionization clouds, which apparently last for 15 to 30 minutes, for comunications. On Christmas morning, 1984, there was supposed to be a Barium cloud, dubbed the Christmas Comet, released over Peru at 70,000 miles (21,336 km) altitude. Unfortunately the test had to be rescheduled, so many persons missed their chance to try, and those who did were apparently unsuccessful. These opportunities, which occur infrequently and often unexpectedly, deserve more attention.

finding direction

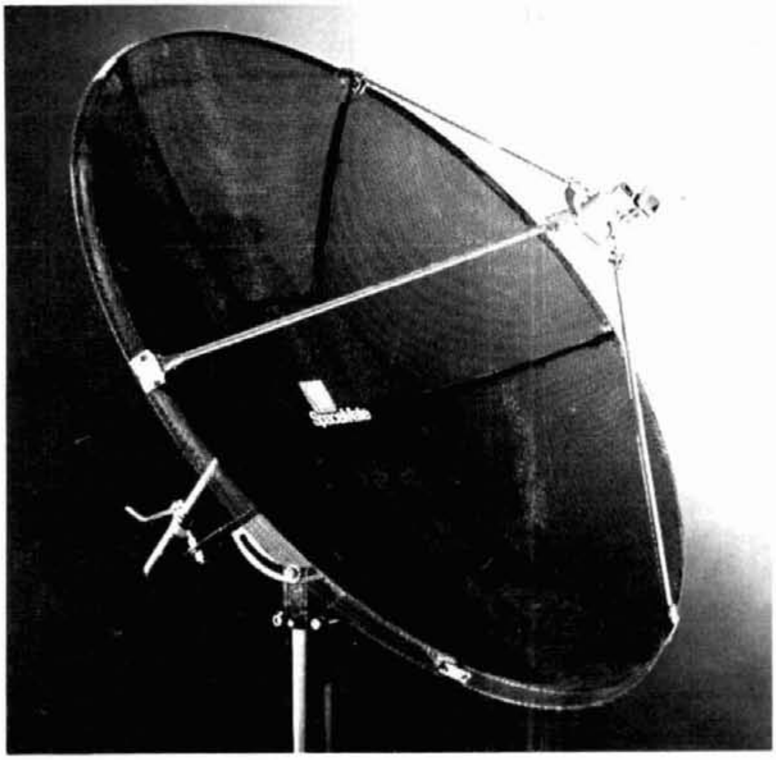
When working DX on the UHF bands, your antenna can have very narrow beamwidths. This requires good rotator accuracy as well as a knowledge of the correct beam headings. One way to calibrate your rotator in the northern hemisphere is to aim your antenna at Polaris (the North Star).

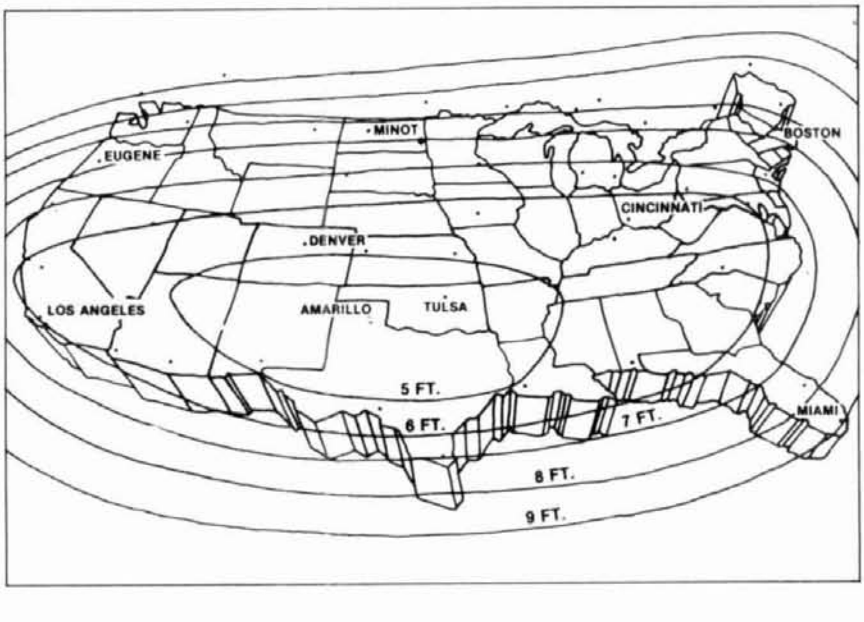
You can also use the sun. By consulting your local daily newspaper for times of sunrise and sunset, you can estimate the time the sun passes directly south. Simply determine the midpoint between sunrise and sunset. For instance, if the sun rises at 5:30 AM and sets at 7 PM local, the time of southerly transit or time when the sun is directly south will be 12:15 PM.

A compass can also be used. But beware — magnetic north may be different than true north. Since many VHFers now use home computers and have direction bearing programs, it is easy to find the true bearing for magnetic north. For USA stations, just compute the direction of the magnetic north pole using the approximate coordinates of 74 degrees north latitude and 101 degrees west longitude. For southern hemisphere stations, the southern magnetic pole is at approximately 68 degrees south latitude and 144 degrees east longitude. This will give you the true direction indicated on a hand compass.

summary

Again, I've run out of time and space, but I hope the information presented will be useful. If you've never seen my July, 1984, column, I suggest

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you obtain a copy of that issue, since this month's column is based on it to a large degree.*

Radio propagation is a fascinating science, and one that can be advanced by the Radio Amateur. New equipment, increased activity, more propagation beacons, and closer attention to possible openings has greatly helped.

acknowledgements

I'd particularly like to thank all those who helped me with encouragement and material on their propagation observations. Special thanks go to Jim Stewart, WA4MVI, for all his help. Thanks also to the many others who helped assemble the DX records, especially: KP4OER, PAØSSB, SM5AGM, VE1UT, K1WHS, WA2SPL, K2UYH, W5FF, W5HUQ, WB5LUA, K6MYC, K8MMM, and ZL3AAD.

references

1. Joe Reisert, W1JR, "VHF/UHF World: The VHF/UHF Primer — An Introduction to Propagation," *ham radio*, July, 1984, page 14.
2. J. H. Nelson, *The Propagation Wizard's Handbook*, a *73* publication, 1978.
3. Graham Knight, GM8FFX, "4-2-70," *Radio Communications*, February, 1980, page 163.
4. Robert B. Rose, K6GKU, "MINIMUF: A Simplified MUF-Prediction Program for Microcomputers," *QST*, December, 1982, page 36.
5. Ernest K. Smith and Edwin W. Davis, "Wind-induced Ions Thwart TV Reception," *IEEE Spectrum*, February, 1981, page 52.
6. Jim Stewart, WA4MVI, "Predicting Sporadic E_s Openings," *Lunar Letter*, May, 1982, page 4.
7. Jim Stewart, WA4MVI, "Sporadic E on 144 MHz-1983," *QST*, February, 1984, page 23.
8. R. A. Ham, BRS15744, "Sporadic-E Observations in 1984," *Radio Communications*, January, 1985, page 44.
9. S. J. Lieberman, WA2FXB, 146 Grove Avenue, Woodbridge, New Jersey 07095. Available from the author at $8.00 to cover cost and mailing.
10. Ken Willis, G8VR, "4-2-70," *Radio Communications*, November, 1983, page 1001.
11. Richard Miller, VE3CIE, Radio Aurora," *QST*, January, 1985, page 14.
12. "Preliminary Report and Forecast of Solar Geophysical Data," available free for qualifying persons from the United States Department of Commerce, NOAA, Space Environmental Service Center, 325 Broadway, R/E/SE2, Boulder, Colorado 80303.
13. John A. Russell, "Did the Perseids Peak in 1980?" *Sky and Telescope*, July, 1982, page 11.
14. Joe Reisert, W1JR, "VHF/UHF World: Improving Meteor Scatter Communications," *ham radio*, June, 1984, page 82.
15. Joe Reisert, W1JR, "VHF/UHF World: Low-Noise GaAs FET Technology," *ham radio*, December, 1984, page 99.
16. Joe Reisert, W1JR, "VHF/UHF World: Stacking Antennas, Part 2," *ham radio*, May, 1985, page 95.
17. Joe Reisert, W1JR, "VHF/UHF World: 220-MHz EME Requirements," *ham radio*, September, 1984, page 45.
18. Rich Rosen, K2RR, Joe Schroeder, W9JUV, and Joe Reisert, W1JR, "220 MHz Under Fire," "Reflections," *ham radio*, October 1984, page 7.
19. Richard Miller, VE3CIE, "VHF Propagation and Meteorology," *QST*, March, 1984, page 30.

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upcoming VHF/UHF events

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July 20-21:	*CQ Magazine VHF WPX Contest*
July 25:	*EME Perigee*
July 27-29:	*Central States VHF Conference, Tulsa, Oklahoma (WØRRY/5)*
July 28:	*Predicted peak of the Delta Acquarids meteor shower (0300 UTC)*
August 3-4:	*ARRL UHF Contest*
August 12:	*Predicted peak of Perseids meteor shower (0130 UTC)*
August 20:	*EME Perigee*

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6.000	2.49
6.176	1.49
7.164112	1.00
7.3728	1.49
8.000	1.49
9.000	1.49
9.90000	1.25
10.69425	2.50
10.8864	1.49
10.920	1.49
11.088	1.59
12.000	2.75
13.440	1.00
14.31818	1.00
15.2	1.10
16.00000	1.50
16.5888	1.49
17.430	2.49
18.000	1.49
18.2259	1.00
18.4320	1.49
20.000	1.50
21.87108	1.00
22.092	1.00
32.000	2.49
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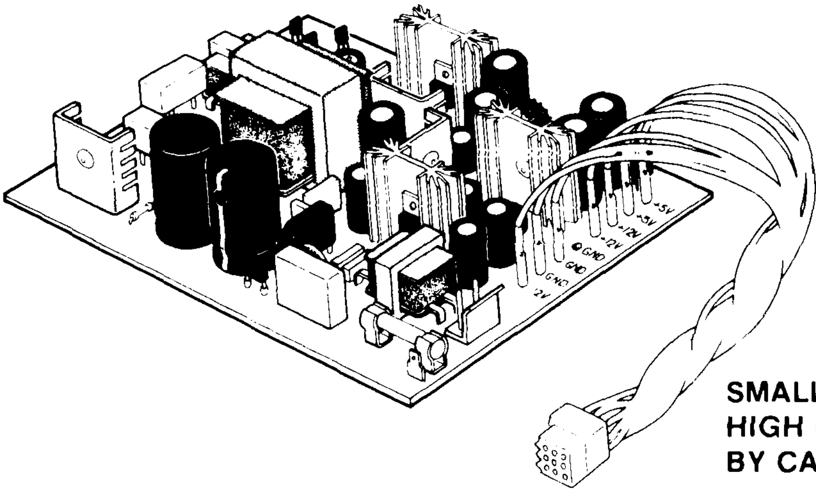

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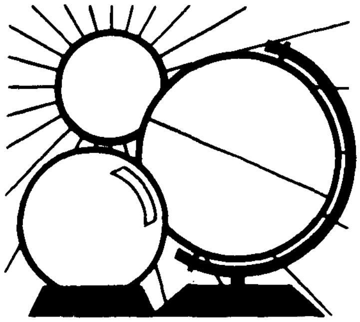

DX FORECASTER

Garth Stonehocker, KØRYW

summertime DX

On the higher frequency bands, 6 through 30 meters, summertime DX is usually very good. Between sporadic-E short-skip openings around noontime and the bands opening earlier and staying open longer, there's plenty of DX fun to keep us happy all day and well into the evening. On 80 and 160, however, received signal levels will be lower because of increased ionospheric absorption, and static will be higher.

This QRN, propagated from the equatorial land regions, increases the overall average noise level of the lower HF bands, peaking at about 10 MHz, dropping somewhat, and then rising sharply just below 4 MHz.

At any given moment, an estimated 3600 thunderstorms are in progress around the world. They can be classified as air-mass, frontal, or orographic, depending on how they are formed. Some are combinations of the three types — that is, an air-mass or frontal storm crossing a mountain range may rise with the change in elevation to become an orographic storm.

Some regions of the country have a greater number and variety of thunderstorms than others. This is measured by the number of thunderstorm days per year. (A thunderstorm day is a day in which at least one storm occurs.) Areas with 100 thunderstorm days or more are found in Florida and in the Rocky Mountains; the southern parts of Louisiana, Alabama, and Georgia see 80 days of thunderstorm activity. A band stretching across Nebraska to Ohio and then bending southward to North Carolina, and another reaching across New Mexico to Northern Texas, see 60 days, and the midwestern states between these bands experience 50 thunderstorm days. The main source of summertime QRN is the air-mass thunderstorm, which builds up from the sun's heating the ground and the air above it.

Most air-mass storms form in afternoons when the humidity is above about 50 percent, and last into the night before cooling off enough to dissipate. Unlike spring or fall frontal passage thunderstorms, which simply pass by, air-mass thunderstorms linger for several days until rain releases their moisture or they slowly move on. During the evening DXing hours air-mass thunderstorm QRN may limit the usefulness of low-band signals to local ragchewing and rule out weak-signal DX.

So how do you get some DXing in on these bands? Most operators switch operating hours, giving up evenings in favor of the pre-dawn hours of early morning. By this time, the thunderstorms have dissipated to the east, locally, and are dissipating on paths to the west. This is a cool, comfortable time of the day to be up and around.

last-minute forecast

The best opportunity for good DX conditions on the higher frequency bands, 10 through 20 meters, will occur during the last week and a half of the month, when the solar flux may be a little higher. (Listen to WWV at 18 minutes after the hour for the solar flux. Any value above 80 is high.) Six meters can have openings anytime during the month. The middle of the month will favor working short-skip both day and night on the lower frequency bands. Disturbances are more likely around the 1st, 9th, 18th, and 28th days of July.

A full moon will occur on the 2nd and 31st; perigee (closest approach of the moon) is on the 25th. The Aquarids meteor shower begins on July 18, peaks on the 28th, and lasts until August 7. (All dates are approximate, but close.) The radio-echo rate at maximum is about 34 per hour.

band-by-band summary

Six-meter paths will open for a half hour to a couple of hours on some days around local noon. Sproadic-E propagation will make this short-skip path possible out to nearly 1200 miles (2000 km) per hop.

Ten, fifteen, twenty, and thirty meters will support DX propagation from most areas of the world during daylight and into the evening with long-skip out to 2000 miles (3500 km) per hop. Sporadic-E short-skip will also be available on many days for several hours near local noon. The direction of propagation will follow the sun across the sky: morning to the east, south at midday, and west in the evening. Long daylight provides many hours of good DXing. Solar flux is so low this year that daytime absorption allows higher signal strengths than usual on these bands during this month.

Thirty, forty, eighty, and one-sixty meters are the nighttime DXer's bands. On many nights 30 and 40 meters will be the only usable bands because of thunderstorm QRN. Try the pre-dawn hours for the best DX. The direction of propagation follows the darkness path across the sky: evening to the east, south around midnight, and toward the west in the pre-dawn hours. Distances will decrease to 1000 miles (1600 km) for skip on these bands. Sproradic-E openings will be most frequently observed around sunrise and sunset. These may be the only signals getting through the noise in the evening. Again, because of low solar flux, daytime DX — particularly in the mornings — may be good this month.

JULY

WESTERN USA

GMT	2300	2200	2100	2000	1900	1800	1700	1600	1500	1400	1300	1200	1100	1000	0900	0800	0700	0600	0500	0400	0300	0200	0100	0000	
PDT	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	
ASIA FAR EAST	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20*	20*	20	20	20	20	20	20	20	20	N
EUROPE	20	20	20	20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	20	20	20	20	20	20	NE
S. AFRICA	15	15	15	15*	15*	15	15	15	15	15	15	20	20	20	20	30	30*	20	20	20	20	20	20	15	E
S. AMERICA	15	15	15	15	15	15	20	20	20	30*	30*	20	20	20	20	20	20	20	15	15	15	15	15	15	SE
ANTARCTICA	20	20	20	20	20	20	20	20	30	30	40	40	30	30	30	30	30	30	30	20	20	20	20	20	S
NEW ZEALAND	15	15	15	15	15	15	15	20	20	20	20	20	20	20	20	20	20	20	15	15	15	10	10	10	SW
OCEANIA AUSTRALIA	15	15	15	15	20	20	20	30	30	20	20	20	20	20	20	15	15	15	15	15	15	15	15	15	W
JAPAN	20	20	20	20	20	20	30	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20	20	NW

MID USA

MDT	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	
ASIA FAR EAST	20	20	20*	20*	20*	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	N
EUROPE	20	20	20	20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	20	20	20	20	20	20	NE
S. AFRICA	15	15	15	15*	15*	15	15	15	15	15	15	20	20	20	20	30	30*	20	20	20	20	20	20	15	E
S. AMERICA	15	15	15	15	15	15	20	20	20	30*	30*	20	20	20	20	20	20	20	15	15	15	15	15	15	SE
ANTARCTICA	20	20	20	20	20	20	20	30	30	30	40	40	40	40	30	30	30	30	30	30	20	20	20	20	S
NEW ZEALAND	15	15	15	15	15	15	15	20	20	20	30*	30*	20	20	20	20	20	20	15	15	15	10	10	10	SW
OCEANIA AUSTRALIA	15	15	15	15	20	20	20	30	30	20	20	20	20	20	20	15	15	15	15	15	15	15	15	15	W
JAPAN	20	20	20	20	20	20	20	30	30	30	30	30	20	20	20	20	20	20	20	20	20	20	20	20	NW
CDT	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	

EASTERN USA

EDT	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	
ASIA FAR EAST	20	20	20	20*	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	N
EUROPE	20	20	20	20	20	20	20	20	20	20	20	30	30	30	30	30	30	30	20	20	20	20	20	20	NE
S. AFRICA	15	15	15	15*	15*	15	15	15	15	15	15	15	20	20	20	30	30*	20	20	20	20	20	20	15	E
CARIBBEAN S. AMERICA	15	15	15	15	15	15	20	20	20	30*	30*	20	20	20	20	20	20	20	15	15	15	15	15	15	SE
ANTARCTICA	20	20	20	20	20	20	20	30	30	30	40	40	40	40	30	30	30	30	30	30	30	20	20	20	S
NEW ZEALAND	15	15	15	15	15	15	15	20	20	20	30*	30*	20	20	20	20	20	20	15	15	15	10	10	10	SW
OCEANIA AUSTRALIA	15	15	15	15	20	20	20	30	30	20	20	20	20	20	20	15	15	15	15	15	15	15	15	15	W
JAPAN	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	NW

The italicized numbers signify the bands to try during the transition and early morning hours, while the standard type provides the MUF during "normal" hours.

*Look at next **higher** band for possible openings.

MEMO

from the desk of **Skip Tenney, W1NLB**

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Program Listing

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Latitude/Longitude Programs
Data File, Beamheadings, DX Display, Sunrise Chart, Greyline, DX Checker

Contest and Duping
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Programming by Ron Nord, N3AKP

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by Don Lancaster

Learning to use a PC can be a real challenge. However, Don Lancaster has tried to filter out all the gobbledygook and make it as easy as can be. Volume 1 features down-to-earth coverage of fundamentals, number systems, hardware and software logic, mainstream codes and standards, electronic memory and memory devices and other applications. Volume 2 covers address space, addressing, system architecture, machine code programming, I/O and helpful suggestions to common problems.
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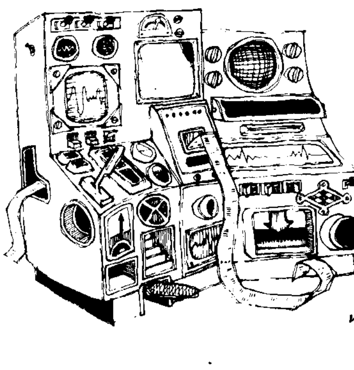

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4CX600J/8809	835.00	6159	13.85	8877	465.00
4CX1000A/8168	242.50*	6159B	23.50	8908	13.00
4CX1000A/8168	485.00	6161	325.00	8950	13.00
4CX1500B/8660	555.00	6280	42.50	8930	137.00
4CX5000A/8170	1100.00	6291	180.00	6L6 Metal	25.00
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4CX15000A/8281	1500.00	6326	P.O.R.	6CA7/EL34	5.38
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4X150D/7609	95.00	7094	250.00	6JG6A	6.28
4X250B	45.00	7117	38.50	6JM6	6.00
4X250F	45.00	7203	P.O.R.	6JN6	6.00
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455KHZ at 3.2KHz wide. May be other models but equivalent. May be used or new. $15.99

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MOTOROLA	4884863B01	11.7MHz 2pole 15KHz bandwidth	5.00
PTI	5350C	12MHz 2pole 15KHz bandwidth	5.00
PTI	5426C	21.4MHz 2pole 15KHz bandwidth	5.00
PTI	1479	10.7MHz 8pole bandwidth 7.5KHz at 3dB, 5KHz at 6dB	20.00
COMTECH	A10300	45MHz 2pole 15KHz bandwidth	6.00
FRC	ERXF-15700	20.6MHz 36KHz wide	10.00
FILTECH	2131	CF 7.825MHz	10.00

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CLEVITE	TO-01A	455KHz+-2KHz bandwidth 4-7% at 3dB	5.00
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MURATA	BFB455B	455KHz	2.50
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	CFM455D	455KHz +-7KHz at 3dB , +-10KHz at 6dB , +-20KHz at 50dB	6.65
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	LF-B8	455KHz	2.90
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2N1692	25.00	2N5922	10.00	40894 RCA	1.00	BLX67	12.25
2N2857	1.55	2N5923	25.00	60247 RCA	25.00	BLX67C3	12.25
2N2857JAN	4.10	2N5941	23.00	61206 RCA	100.00	BLX93C3	22.21
2N2857JANTX	4.50	2N5942	40.00	62800A RCA	60.00	BLY87A	7.50
2N2876	13.50	2N5944	10.35	62803 RCA	100.00	BLY88C3	13.08
2N2947	18.35	2N5945	10.00	430414/3990RCA	50.00	BLY89C	13.00
2N2948	13.00	2N5946	12.00	3457159 RCA	20.00	BLY90	45.00
2N2949	15.50	2N5947	9.20	3729685-2 RCA	75.00	BLY92	13.30
2N3118	5.00	2N6080	6.00	3729701-2 RCA	50.00	BLY94C	45.00
2N3119	4.00	2N6081	7.00	3753883 RCA	50.00	BLY351	10.00
2N3134	1.15	2N6082	9.00	615467-902	25.00	BLY568C/CF	30.00
2N3287	4.90	2N6083	9.50	615467-903	40.00	C2M70-28R	92.70
2N3288	4.40	2N6084	12.00	2SC568	2.50	C25-28	57.00
2N3309	4.85	2N6094	11.00	2SC703	36.00	C4005	2.50
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2N3632	15.50	2N6136	21.85	2SC1070	2.50	CD2545	24.00
2N3733	11.00	2N6166	40.24	2SC1216	2.50	CD2664A	16.00
2N3818	5.00	2N6267	142.00	2SC1239	2.50	CD3167	92.70
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2N3866AJANTXV	5.30	2N6567	10.06	2SC1600	5.00	CM40-12	27.90
2N3924	3.35	2N6603	13.50	2SC1678	2.00	CM40-28	56.90
2N3926	16.10	2N6604	13.50	2SC1729	32.40	CME50-12	30.00
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2N3950	25.00	021-1	15.00	2SC1945	10.00	CTC3005	70.00
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2N4430	11.80	281-1	15.00	A209	10.00	EN15745	20.00
2N4927	3.90	282-1	30.00	A283	6.00	FJ9540	16.00
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2N5016	18.40	698-3	15.00	AF102	2.50	G65386	25.00
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2N5109	1.70	733-2	15.00	B3-12	10.85	HEPS3005	10.00
2N5160	3.45	798-2	25.00	B12-12	15.70	HEPS3006	19.90
2N5177	21.62	3421	28.00	BAL0204125	152.95	HEPS3007	25.00
2N5179	1.04	3683P1	15.00	BF25-35	56.25	HEPS3010	11.34
2N5216	56.00	3992	25.00	B40-12	19.25	HF8003	10.00
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2N5764	27.00	40280 RCA	4.62	BFX85	2.50	J310	1.00
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2N5842	8.45	40282 RCA	20.00	BFX89	1.00	J02001	25.00
2N5847	19.90	40290 RCA	2.80	BFY11	2.50	J04045	24.00
2N5849	20.00	40292 RCA	13.05	BFY18	2.50	KD5522	25.00
2N5913	3.25	40294 RCA	2.50	BFY19	2.50	KJ5522	25.00
2N5916	36.00	40341 RCA	21.00	BFY39	2.50	M1106	13.75

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M1132	7.25	MRF466	18.97	NE13783	61.00	SD1012	10.00
M1134	13.40	MRF472	1.50	NE21889	43.00	SD1012-3	10.00
M9116	29.10	MRF475	3.10	NE57835	5.70	SD1012-5	10.00
M9579	6.00	MRF476	3.16	NE64360ER-A	100.00	SD1013	10.00
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MM1810	15.00	MRF901 3 Lead	1.00	PT5632	4.70	SD1076	18.50
MM1943	1.80	MRF901 4 Lead	2.00	PT5749	25.00	SD1077	4.00
MM2608	5.00	MRF902/2N6603JAN	15.00	PT6612	25.00	SD1077-4	4.00
MM3375A	17.10	MRF902B	18.40	PT6619	20.00	SD1077-6	4.00
MM4429	10.00	MRF904	2.30	PT6708	25.00	SD1078-6	24.00
MM8000	1.15	MRF905	2.55	PT6709	25.00	SD1080-7	7.50
MM8006	2.30	MRF911	2.50	PT6720	25.00	SD1080-8	6.00
MM8011	25.00	MRF965	2.55	PT8510	15.00	SD1080-9	3.00
MPSU31	1.01	MRF966	3.55	PT8524	25.00	SD1084	8.00
MRA2023-1.5	42.50	MRF1000MA	32.77	PT8609	25.00	SD1087	15.00
MRF134	10.50	MRF1004M	31.05	PT8633	25.00	SD1088	22.00
MRF136	16.00	MRF2001	41.74	PT8639	25.00	SD1088-8	22.00
MRF171	35.00	MRF2005	54.97	PT8659	25.00	SD1089-5	15.00
MRF208	11.50	MRF5176	24.00	PT8679	25.00	SD1090	15.00
MRF212	16.10	MRF8004	2.10	PT8708	20.00	SD1094	15.00
MRF221	10.00	MSC1720-12	225.00	PT8709	20.00	SD1095	15.00
MRF223	13.00	MSC1821-3	125.00	PT8727	29.00	SD1098-1	30.00
MRF224	13.50	MSC1821-10	225.00	PT8731	25.00	SD1100	5.00
MRF227	3.45	MSC2001	30.00	PT8742	19.10	SD1109	18.00
MRF230	2.00	MSC2010	93.00	PT8787	25.00	SD1115-2	7.50
MRF231	10.00	MSC2223-10	245.00	PT8828	25.00	SD1115-3	7.50
MRF232	12.07	MSC2302	POR	PT9700	25.00	SD1115-7	2.10
MRF237	3.15	MSC3000	35.00	PT9702	25.00	SD1116	5.00
MRF238	13.80	MSC3001	38.00	PT9783	16.50	SD1118	22.00
MRF239	17.25	MSC72002	POR	PT9784	32.70	SD1119	5.00
MRF245	35.65	MSC73001	POR	PT9790	56.00	SD1124	50.00
MRF247	31.00	MSC80064	35.00	PT31083	20.00	SD1132-1	15.00
MRF304	36.00	MSC80091	10.00	PT31962	20.00	SD1132-4	12.00
MRF306	50.00	MSC80099	3.00	PTX6680	20.00	SD1133	9.50
MRF313	11.15	MSC80593	POR	RE3754	25.00	SD1133-1	10.00
MRF314	29.21	MSC80758	POR	RE3789	25.00	SD1134-1	2.50
MRF315	28.86	MSC82001	33.00	RF35	16.00	SD1134-4	12.00
MRF316	55.43	MSC82014	33.00	RF85	17.50	SD1134-17	12.00
MRF317	63.94	MSC82020M	130.00	RF110	21.00	SD1135	10.25
MRF412	18.00	MSC82030	33.00	S50-12	23.80	SD1135-3	12.00
MRF420	20.12	MSC83001	40.00	S3006	15.00	SD1136	12.50
MRF421	25.00	MSC83003	82.00	S3007	10.00	SD1136-2	12.50
MRF422	38.00	MSC83005	70.00	S3031	22.00	SD1143-1	10.00
MRF427	17.25	MSC83026	POR	SCA3522	5.00	SD1143-3	17.00
MRF428	63.00	MSC83303	POR	SCA3523	5.00	SD1144	4.00
MRF433	12.07	MSC84900	60.00	SD345	5.00	SD1145-5	15.00
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SD1214-11	5.00	SD1317	8.00	SD1477	35.00	SRF2147	22.00	SD1272-1	10.95	SD1428- 6084	12.00	SD1546H1	55.00	SS4152	15.00
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SD1219-5	15.00	SD1347-1	1.00	SD1484	1.50	SRF2265	100.00	SD1278	13.75	SD1429-5	15.00	SD1575	6.95	TA8561	15.00
SD1219-8	15.00	SD1365-1	2.50	SD1484-5	1.50	SRF2281	5.00	SD1278-1	13.75	SD1430	12.00	SF4557	25.00	TA8562	15.00
SD1220	8.00	SD1365-5	2.50	SD1484-6	1.50	SRF2371	15.00	SD1278-5	13.75	SD1430-2	18.00	SK3048	5.00	TA8563	15.00
SD1220-1	9.50	SD1375	7.50	SD1484-7	1.50	SRF2347	50.00	SD1279-1	18.00	SD1434	28.00	SL501-59	15.00	TA8564	15.00
SD1220-9	8.00	SD1375-6	7.50	SD1488	22.85	SRF2356	38.00	SD1279-3	18.00	SD1434-5	28.00	SL501-173	15.00	TA8894	15.00
SD1222-8	16.00	SD1379	15.00	SD1488-1	28.00	SRF2378	16.00	SD1281-2	8.00	SD1434-9	28.00	SM7714	5.00	TIS189	3.55
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SD1224-10	18.00	SD1380-3	1.00	SD1488-8	28.00	SRF2584	40.00	SD1283-2	10.60	SD1441	56.00	SRF395	50.00	TP1014	5.00
SD1225	18.00	SD1380-7	1.00	SD1499-1	36.00	SRF2597	25.00	SD1283-3	10.00	SD1442	15.00	SRF750	36.00	TP1028	15.00
SD1225-1	15.00	SD1405	21.00	SD1511H3	75.00	SRF2741	40.00	SD1283-4	10.00	SD1444	3.25	SRF769B	20.00	TRW3	5.00
SD1229-7	10.95	SD1408	25.00	SD1520-2	18.00	SRF2747	40.00	SD1289-1	15.00	SD1444-8	3.25	SRF887K3	2.50	TXVF2201/HP	450.00
SD1229-16	10.95	SD1409	18.00	SD1522-4	33.00	SRF2767H	40.00	SD1290-4	15.00	SD1444-9	3.25	SRF989K	15.00	V222-2	25.00
SD1232	4.00	SD1410	18.00	SD1528-1	24.00	SRF2821	25.00	SD1290-7	15.00	SD1446	4.03	SRF1005	50.00	V4101E	20.00
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PRICES: Prices are subject to change without notice.

PURCHASE ORDERS: We accept purchase orders accompanied by a check. All others must have prior approval by management.

RESTOCK CHARGES: If parts are returned to MHz Electronics, Inc. due to customer error, the customer will be held responsible for all fees incurred and will be charged a 15% restocking fee with the reminder in CREDIT ONLY. Return authorization must be obtained within 5 working days of receipt of the parcel, otherwise the order will be considered complete. The following must accompany any return: A copy of our invoice, return authorization number which must be obtained prior to shipping merchandise back and must appear on the outside of the package. Return authorizations can be obtained by calling (602) 265-0731. Return authorizations will not be given out on the 800 number. All items must be properly packed and insured. We will not give any credit on items which are damaged due to improper packing.

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NEW products

Kenwood TS-940S HF transceiver

Kenwood has announced the release of its new HF transceiver, the TS-940S. Designed with the serious HF operator in mind, the TS-940S features all the latest state-of-the-art features. High performance interference rejection circuits and a high dynamic range receiver, combined

with a superior transmitter and excellent audio, provide power for working those really tough ones. Casual DXers as well as contest operators give Kenwood high marks for QRM fighting features such as SSB slope tuning, variable CW bandwidth, notch, AF tune and CW pitch controls.

The TS-940S covers all HF Amateur bands — including the new WARC bands — and is a general coverage receiver for 150 kHz to 30 MHz. Fully self-contained, the unit will operate on FM, SSB, CW, AM, and FSK RTTY; there are no extra modules to buy. The TS-940S has two optically encoded VFOs and features 40 nonvolatile memory channels in four groups of ten. You can QSY instantly by using the keyboard on the front panel; just enter the frequency you want. The TS-940S has an LCD sub-display that shows CW, VBT, SSB slope tuning as well as frequency, time and status of the optional AT-940 160-10 meter automatic antenna tuner.

Kenwood offers a full line of optional accessories such as the AT-940 160-10 meter automatic antenna tuner, SP-940S external speaker with audio filtering, a full line of both first and second IF crystal filters so that performance can be tailored to individual tastes, and the VS-1 voice synthesizer, to name just a few.

For more information, contact Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

A5 switches focus, changes name, and offers free samples to *ham radio* readers

After 18 years of providing in-depth reporting of news and technical developments in Fast Scan TV, *A5* is expanding its range to include coverage of other modes of specialized communications in Amateur Radio. While FSTV will remain the primary object of interest, NBTV, MSTV, SATV, TVRO, SSTV, FAX, RTTY, AMTOR, Packet, OSCAR, EME, and other modes will be addressed in an extended format.

With the change in editorial focus comes a new name: *SPEC-COM.®* *SPEC-COM* will be published ten times a year. One-year subscriptions are available for $20; special six-month trial subscriptions are available to new readers at $10.

For a free sample copy and further details, contact *SPEC-COM — Specialized Communications Journal*, P.O. Box H, Lowden, Iowa 52255. (Allow two to three weeks for delivery.)

cable ties

Available in packages of 20 ($7.00), FLEXLOC reusable cable ties are ideal for bunching cables attached to Amateur Radio equipment, computers and peripherals, home entertainment systems, A/V devices, and other electronic and electrical hardware. Their quick-release ("pinch of the fingers") lock enables repeated re-use. Made from tough, flexible nylon (Type 66), FLEXLOC has a tensile strength of 50 pounds. Each 10-inch fastening strap is self-locking with a ribbed backing that permits diameter adjustments up to 2-3/4 inches and secures the bundle until release.

NEW products

For further information, contact Visual Departures, Ltd., 1641 Third Avenue, Suite 202, New York, New York 10128.

Circle #302 on Reader Service Card.

full half-wave UHF antenna for portables

Larsen Antenna's new KD 14-450-HW antenna, a full half-wave UHF antenna for portables, interfaces with any BNC output portable. Said to offer performance equivalent to a full quarter wave on a perfect ground plane, the KD 14-450-HW is appropriate for any UHF application requiring maximum performance. Because of its inherent resonance, it may be easily remoted via a coaxial line from the portable. The overall whip length is 12 inches; the impedance transformer at the base of the whip is 3.25 inches long.

For more information, contact Larsen Electronics, P.O. Box 1799, Vancouver, Washington 98668.

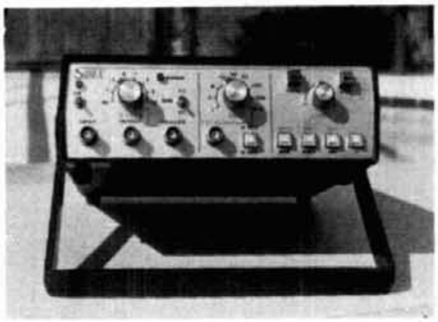
Circle #303 on Reader Service Card.

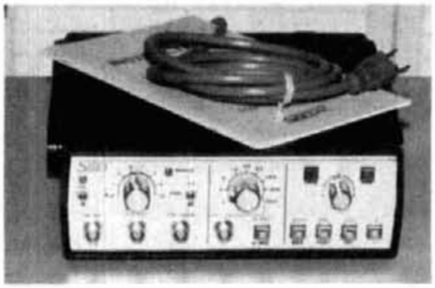
scope memory

Sibex, Inc. has introduced a new device called the Scope Memory. This instrument attaches to your oscilloscope and converts it into a high performance digital storage scope. The Scope Memory can be an economical answer for the service technician, hobbyist, or manufacturing firm that needs a storage scope but cannot justify its expense.

The Scope Memory stores low frequency signals, transients, and one-shot pulses in a single sweep. It stores both analog and digital signals and features 18-selectable sampling times with a 1.4 MHz maximum rate, an 8-range input selector with over-range indication and a wide variety of triggering modes.

The pre- and post-trigger modes allow viewing the waveform that occurs both before and after an event. This feature makes the device a





useful tool for trouble shooting. The price is $515.00 plus shipping.

For additional information, contact Sibex, Inc., 2340 State Road 580, Suite 241, Clearwater, Florida 33515.

Circle #304 on Reader Service Card.

ATV transceivers

P.C. Electronics has introduced a new compact 1-watt 70-cm ATV transceiver aimed at introducing hams to the video mode.

The TC70-1 ATV transceiver accepts standard composite video input from any source. Video and audio input RCA jacks on the rear panel are provided for connection to black and white or color cameras, computers, VCRs, and TVROs. A front panel switch selects video and audio input from these jacks or from the 10-pin connector provided for direct connection to many of the popular color cameras made for portable VCRs.

Audio input is selected from the color camera microphone or line level from the rear panel jack. In addition there is a microphone input that accepts any low impedance dynamic microphone. Next to the microphone input is a mini jack for PTL. A "push-to-look" feature resembles push-to-talk on audio-only transceivers, can be used for microphone or remote transmit receive switching or the front panel toggle switch may be used.

Full-color live action video and sound are transmitted with over 1 watt PEP on one or two selected crystal controlled frequencies in the range of 425 to 440 MHz in the 70-cm Amateur band. The line-of-sight snow-free radius with TC70-1s and KLM 440-27 antennas at each end is 15 miles. The unit was made small and compact (7 × 7 × 2.5 inches) for portable use, but either a 20-watt or 50-watt video compensated RF linear amplifier for greater distance, base or mobile, is available.

NEW products

With the TC70-1, the only other items necessary to get on ATV are a good 70-cm antenna, low loss coax, a TV set, and any device with a standard 1 volt P-P composite video output commonly found on black and white CCTV cameras, home video color cameras and VCRs, computers, and RTTY/video converters. A Technician class or higher Amateur radio license is required for purchase of this equipment from P.C. Electronics and subsequent operation.

Priced under $300, the TC70-1 makes getting on this exciting visual mode affordable. For further information, contact P.C. Electronics, 2522 Paxson Lane, Arcadia, California 91006.

Circle #305 on Reader Service Card.

antenna rotator

The AR-200XL antenna rotator operates from 115 VAC and provides 220 pounds/inch torque to turn an antenna array or surveillance camera. Full 360-degree rotation is achieved in 60 seconds. Motor voltages are held below 18 VAC for safety and only three conductors are required between the control unit and rotator. The control unit incorporates a demand heading control and a present heading indicator presented concentrically on a compass rose. Designed for medium-duty applications, the rotator will support a vertical load of up to 100 pounds with a wind loading of 5 square feet.

For further information, contact CMC Communications, Inc., 5479 Jetport Industrial Boulevard, Tampa, Florida 33614.

Circle #306 on Reader Service Card.

new receivers

Yaesu Electronics has announced two additions to its line of high-performance receiver products.

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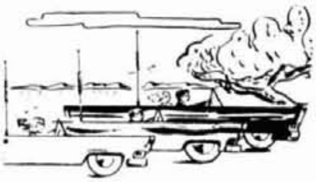

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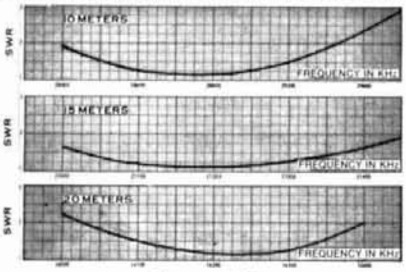

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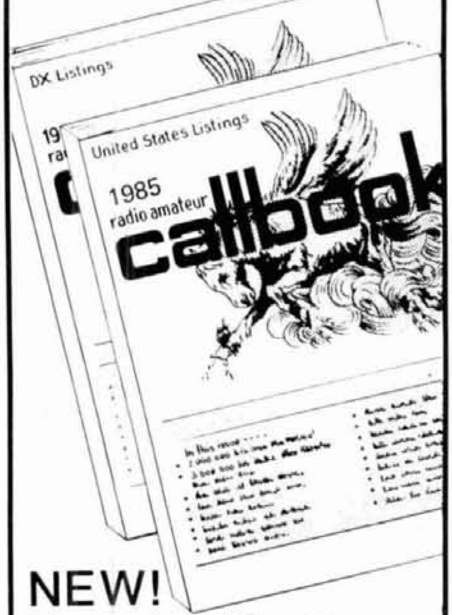

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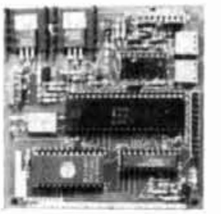

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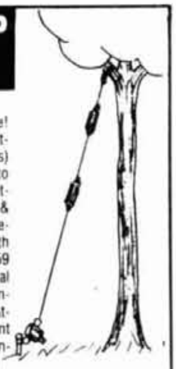

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SOUTH CAROLINA: Charleston Hamfest, sponsored by the Charleston Amateur Radio Society, July 13 and 14 at the Omar Shrine Temple, East Bay Street. 8:30 to 4:00 Saturday, 9:00 to 4:00 Sunday. General admission $5.00 includes admission to Hospitality Room, 7:30 PM to 11 PM Saturday. 12 and under free. FCC exams Saturday. Buffet available both days. Flea market tables $5. Commercial booths $40. Talk in on 146.19/79. For information contact: Hamfest Committee, PO Box 70341, Charleston, SC 29405 or (808) 747-2324 or 554-8058.

IOWA: The Des Moines Radio Amateur Association will hold an Electronic Fair, Airport Hilton Inn, Des Moines, July 20 and 21. The Electronic Fair combines the Iowa ARRL Convention with what was the Des Moines Hamfest. General public admission fee $2.00. Flea market parking $3.00. Saturday evening banquet $15.00 per person. Featured banquet speaker Nick Johnson. There will be seminars both days for computer and satellite enthusiasts, Amateur Radio operators and spouses. For further information: Des Moines Radio Amateur Association, PO Box 88, Des Moines, IA 50301.

MINNESOTA: The St. Cloud Amateur Radio Club Hamfest, August 11, Sauk Rapids Municipal Park, off MN Hwy 15 (Benton Drive). Displays, demonstrations and trades. Ticket donation $3. Extra ticket $2. Snack counter. Talk in 34/94 primary; 615/015 secondary. Contact: SCARC, Box 141, St. Cloud, MN 56302.

KENTUCKY: The Central Kentucky ARRL Hamfest, sponsored by the Bluegrass ARS, Sunday, August 11, 8 AM to 5 PM, Scott County HS, Longlick Road and US 25, Georgetown. Tech forums, license exams, awards and exhibits. Air conditioned facilities. Free outdoor flea market space. Tickets $3.50 advance and $4.00 at gate. Talk in on 76/16. For information or tickets SASE to Scott Hackney, KI4LE, 629 Craig Lane, Georgetown, KY 40324.

MISSOURI: The 23rd annual Zero-Beaters ARC Hamfest, July 21, 9 AM to 3 PM, Washington, MO Fairgrounds. Free admission. Free flea market area. Limited rental spaces under pavillion. Advance reservation advised. FCC exams, cake walk, candy scramble, traders tow, refreshments and food available. Talk in on 147.24-84, 146.52. For information: Zero-Beaters ARC, Box 24, Dutzow, MO 63342.

NORTH CAROLINA: The Western Carolina Amateur Radio Society's annual Hamfest, July 27 and 28 at Buncombe County Fireman's Training Center, Asheville. Admission $4 at gate, $3.50 advance. Free parking, camping (no hookups), forums, and VEC exams will be available. Outside flea market sites — bring own table. Talk in on 16/76 and 31/91. For advance tickets contact: Marvin Soloman, KI4EA, 14 Carjen Avenue, Asheville, NC 28804. All other inquiries to: Earl Elliott, KI4UO, 17 Emory Road, Asheville, NC 28806.

PENNSYLVANIA: The Foothills ARC's 17th annual Greensburg Hamfest, Nevin Arena, Sunday, July 28. Tickets $2.00 or 3/$5.00. Indoor tables $5.00. Tailgating $2.00. Refreshments. Mobile check in on 147.78/18. For further information, registration or tables: F.A.C.R., PO Box 236, Greensburg, PA 15601 or contact WB3KJH.

INDIANA: The WA9SNT Amateur Radio Club will hold its annual Swapfest, August 4, ITT Technical Institute, 9511 Angola Court, Indianapolis. 8 AM to 4 PM. Admission $2.00. Students $1.00. Flea market space $1.00 addit. Talk in on 146.94 and 3910± . For information: Dave Johnston, K9HDQ, ITT Technical Institute, 9511 Angola Court, Indianapolis, IN 46268. (317) 875-8640.

FLORIDA: The 12th annual Greater Jacksonville Hamfest, August 3 and 4, Jacksonville Civic Auditorium, Saturday 8 to 5 PM; Sunday 9 to 3 PM. Registration $4.00. Children under 16 admitted free. Reserved swap tables $9.00/1 day; $15.00/both days. FCC exams for all grades Saturday at 1 PM on a walk-in basis. For information and registration: SASE to Jacksonville Hamfest Assn., PO Box 23134, Jacksonville, FL 32241.

MICHIGAN: The Straits Area ARC is having its 12th annual Swap 'N Shop, July 20, Emmet County Fairgrounds, Petoskey. 9 AM to 2 PM. General admission $2.50. Single table $3.00. Refreshments available. Free parking Friday night for self-contained RV's. Petoskey State Park nearby. Come and bring the family. Talk in on 07/67 and 52. For further information: Joe Werden, WD8MJB, PO Box 444, Conway, MI (616) 347-8693. Please SASE.

1985 BLOSSOMLAND BLAST, Sunday, October 6, 1985. Write "BLAST", PO Box 175, St. Joseph, MI 49085.

WISCONSIN: The Oshkosh Amateur Radio Club in conjunction with the S.O.L.A.R. Assn. will host EAA hams for the 1985 convention, July 26 - August 2. Stop and rest, charge your batteries, leave messages, etc at the EAA Ham Shack located at the north end of the commercial exhibit area. Look for the red and white ARRL flag. On Saturday, July 27 at 3 PM, there will be a gathering for all EAA hams hosted by the Oshkosh ARC. We'll be serving bratwurst, burgers and refreshments free of charge. Bring your wives and kids. You're in for a treat! For further info: Forest Schafer, WD9IWL, 417 Willow St., Omro, WI 54963.

WEST VIRGINIA: Wheeling Hamfest and Computer Fair, Wheeling Park, Sunday, July 21. Dealers welcome. Flea market, ARRL, AMSAT, SWOT, SMIRK booths. Family activities available at Park. Admission $3.00. To reserve space contact Jay Paulovicks, KD8GL, RD 3, Box 238, Wheeling, WV 26003. (304) 232-6796 or TSRAC, Box 240, RD 1, Adena, OH 43901 (614) 546-3930.

CQ CONTEST: VHF'ers please note! The first annual CQ World Wide VHF WPX Contest is July 20-22, 50 thru 1296 MHZ. For details, logsheets, etc., write to SCORE, PO Box 1161, Denville, NJ 07834 or to CQ Magazine. We need your entry to make this a success.

WISCONSIN: The South Milwaukee Amateur Radio Club's annual Swapfest, Saturday, July 13, American Legion Post #434, 9327 South Shepard Avenue, Oak Creek. Activities start about 7 AM and will run through 4 PM. Parking, picnic area, food and refreshments available. Free overnight camping. Admission $3.00 and includes a free beverage. The Milwaukee Volunteer Core Group will conduct Amateur Radio exams during the day. For more details and a map: South Milwaukee ARC, PO Box 102, South Milwaukee, WI 53172-0102.

NEW JERSEY: (Augusta) July 20: The Sussex County ARC will sponsor SCARC '85 at the Sussex County Fairground, Plains Rd., off Rt. 206. Doors open 8 AM. Registration $2.00. Indoor tables $7.00 each. Tailgate space $5.00. Food and refreshments. Free parking. Talk in on 147.90/30 and 146.52. For further information: Donald R. Stickle, K2OX, Weldon Rd., RD #4, Lake Hopatcong, NJ 07849. (201) 663-0677.

CALIFORNIA: The first International Youth Tele-congress will convene in Santa Cruz, July 19 to 23. The goal is to link young people around the world via Amateur Radio and computer bulletin board networks. For information: Redwood Youth Foundation, 5300 Glen Haven Road, Soquel, CA 95073. (408) 476-2905 or (408) 662-0300. WA6KFA.

WEST VIRGINIA: The 7th annual TSRAC Wheeling Hamfest and Computer Fair, Sunday, July 21, Wheeling Park, 9 AM to 4 PM. Easy access, dealers, exhibits all under roof. 5 acres Flea Market. Refreshments, free parking, family park activities. Admission $3.00. ARRL, AMSAT, SWOT, SMIRK, etc. For information and map: Jay Paulovicks, KD8GL, RD 3, Box 238, Wheeling, WV 26003. (304) 232-6796 or TSRAC, Box 240, RD 1, Adena, OH 43901 (614) 546-3930.

NORTH CAROLINA: The 13th annual Mid-Summer Swapfest, sponsored by the Cary ARC, Saturday, July 20, 9 AM to 3 PM, Lion's Club Shelter, Cary. Talk in on 80-30, 146.28/.88, 30-2, 147.75/.15, 2-0, 146.52/.52. For information: Cary ARC, PO Box 53, Cary, NC 27511.

BRITISH COLUMBIA: Okanagan International Hamfest, July 27 and 28, Oliver Centennial Park, Oliver. Registration July 27 at 9 AM. Activities Saturday, July 27 at 1 PM and Sunday July 28 at 2:30 PM. Saturday potluck supper. Talk in on 146.34/94 OKN Rpt 76/76. For further info: Lota Harvey, VE7DKL, 584 Heather Rd., Penticton, BC V2A 1W8. (604) 492-5768.

BRITISH COLUMBIA: Maple Ridge Hamfest, July 13 and 14, St. Patricks Center, 22589 — 121 Avenue, Maple Ridge. Admission: Hams $5.00; non-hams $2.00. Food, swap & shop, commercial displays, bunny hunt and family activities. Close to shopping and swimming. Camper space, no hookups. Talk in on 3.758 MHz 146/20/80 and 146.34/94. For information and a 20% pre-registration discount: Maple Ridge ARC, Box 292 Maple Ridge, BC, Canada V2X 7G2.

MARYLAND: The Baltimore Radio Amateur Television Society's famous BRATS Maryland Hamfest and Computerfest, Sunday, July 28, Howard County Fairgrounds, Rt. 144, near I-70, West Friendship. Over 175 tables all indoors. Tailgating $3.00 per space. RV hookups available on grounds. Nearby motels. Free walk-in VE exams. For further information/table reservations: Mayer Zimmerman, W3GXK, BRATS, PO Box 5915, Baltimore, MD 21208.

NEW YORK: The Mt. Beacon ARC Hamfest, Saturday, July 20, Arlington Senior High School, Poughkeepsie/Lagrange. Tickets $2.00. Non-hams and children admitted free. Tailgate space $3.00. Tables $4.00. Doors open 8 AM. Talk in on 146.37/97 and 146.52. For information: Julius Jones, W2IHY, RR2, Vanessa Ln, Staatsburg, NY 12580. (914) 889-4933.

COLORADO: Amateur Radio Motorcycle Club Rocky Mountain Roundup III will be held somewhere west of Denver. Riding radio operators check the ARMC net Thursday nights, 0300 UTC, 7237.5 kHz. Send business SASE to AG0N, Gary McDuffie, Rt. 1, Box 464, Bayard, NE 69334 and ask for net information.

MASSACHUSETTS: The first ARRL Heavy Hitters Hamfest, July 20 and 21, Topsfield Fairgrounds, US 1, Topsfield. 9 to 4 both days. Giant flea market, ARRL, PACKET, AMSAT, ATV and more. License exams held at nearby school. For reservations send completed 610 form and $4.00 check payable to ARRL/VEC, copy of current license and SASE for confirmation to: Topsfield Exams, c/o PO Box 71, Hanover, MA 02339 by June 21. Sorry no Novice exams. Free camping Saturday night for tents and self-contained RV's. Nearby hotels. Advance tickets $3.00. $4.00 at door. Non-ham spouses and kids admitted free. Talk in on 146.64 and 147.285 repeaters. For information: Russ Corkum, WA1TTV, 21 Thorndike Street, Arlington, MA 02174.

OPERATING EVENTS

"Things to do..."

The Eastern Michigan ARC will commemorate the annual Port Huron to Mackinac Island Yacht Race, July 20 and 21 from 1400 Z to 0200 Z both days. Listen for K8EPV. For a certificate send QSL with legal-size SASE to K8EPV (C.B.A.) or 654 Georgia, Marysville, MI 48040.

A direct Trans-Atlantic QSO on 2 meters — can it be done? The attempt is being organized by the West Kent Amateur Radio Society and will take place between August 19 and 30. Arrangements for skeds (high power stations only please) can be made by contacting Dave Green, G4OTV, 13 Culverden Down, Tunbridge Wells, Kent, TN4 9SB, England. Tel: 892-28275.

Vaynesboro, Virginia Parks and Recreations Department and the Valley Amateur Radio Association will operate special event station KI4BR in Ridgeview Park in celebration of "Summer Extravaganza". 1700 hours C.T.U. on Saturday and Sunday, July 13 and 14. A "First Edition Certificate" will acknowledge QSO and receipt of QSL. SASE to KI4BR, PO Box 565, Waynesboro, VA 22980.

The Southern Michigan Amateur Radio Society will operate W8DF/8 during the 7th World Hot-Air Balloon Championship, July 13 to 21, Kellogg Regional Airport, Battle Creek, Michigan. Phone: center of General 80-10 meters and CW in Novice bands. For a special QSL SASE to PO Box 934, Battle Creek, MI 49016.

Riding Radio Operators — Amateur Radio Motorcycle Club Net meets every Thursday night at 0300 UTC at 3888 kHz standard time and 7237.5 kHz daylight saving time. An eastern USA group meets one hour earlier at 3888 kHz year-round. Send business SASE to AG0N, Gary McDuffie, Rt. 1, Box 464, Bayard, NE 69334 and ask for net information.

July 7-13: The Cherryland ARC will operate special events station KA8QVH to commemorate the National Cherry Festival, Traverse City, MI. 1100Z July 7 thru 0200Z July 13 daily. Send large SASE with QSL to Ed Irwin, 346 Peninsula Trail, Traverse City, MI 49684 for an attractive certificate.

July 27: CARS Third annual SPACE DAY special event station will be on the air 0000 GMT July 27 to 1900 GMT July 28. For a certificate send QSL and $1.00 postage to CARS, PO Box 512, Jackson, MI 49204.

July 19, 20: The Indian Hills Community College ARC will operate special events station WA0IUQ during the 1985 Ottumwa Hot-Air Balloon Races. 2200 GMT to 0400 GMT on SSB only each day. For a commemorative QSL send your QSL with SASE to WA0IUQ at Callbook address.

WIA 75 AWARD: March 1 to December 31, 1985: The world's first and oldest radio society, Wireless Institute of Australia is celebrating its 75th anniversary. To qualify for the WIA award, Australian Amateurs and SWL's must log 75 members of WIA: Overseas Amateurs and SWL's contact station VK75A; contact Amateur already qualified for WIA 75 award; contact 75 WIA members and log membership numbers. Send info plus $2 for certificate and s&h to: WIA 75 Award Manager, Wireless Inst. of Australia, 412 Brunswick St., Fitzroy 3065, Victoria, Australia.

July 25: The Kauai Amateur Radio Club is planning an expedition to Hawaii's 5th county, Kalawao County on the island of Molokai. Callsign KH6F on July 25, 26, 27 and 28. 80, 40, 20, 15 10 and 2 meters. SSB, FM, CW. Send QSL and SASE or IRC to KH6F, PO Box 675, Koloa, HI 96756.

THE GUERRI REPORT

Ernie Guerri
W6MGI

maybe — and that's final!

The earliest developers of logical concepts were essentially philosophers who accommodated the notion that not every question had an answer that was clearly black or white. "It all depends . . ." was a perfectly valid answer to some questions.

During the Renaissance there was a significant effort to minimize indeterminate answers to clear-cut questions, mostly as an accommodation to the growing influence of scientists, for whom things either "were" or "weren't." This trend has continued to the present, with a growing gap between the "certainty" of scientific dogma and the "softness" of philosophic postulation. The birth of the electronic computer age in the middle of this century gave the final imprimatur to determinate logic; everything was either one or zero, and every entity in the universe could be logically diminished into finite elements which either "were" or "weren't."

Two important developments in modern science are making things less certain than they seem to have been between 1500 and 1950. First, the observation of over 200 "basic" atomic characteristics has many theoretical physicists contemplating the concept that the physical universe may extend indefinitely in both the micro and macro directions. Second, the desire to implement artificial intelligence in robot devices has given renewed credence to the philosophers' acceptance of "maybe" as a valid answer. This new class of indeterminate logic, or "fuzzy logic" as some call it, is characterized by the general concept that the consequences of events are not necessarily certain, nor need they be — and that some inferences which have no obvious mathematical value can improve the precision of a logical decision. A clearer picture of these concepts may be had from a graphic representation (**fig. 1**).

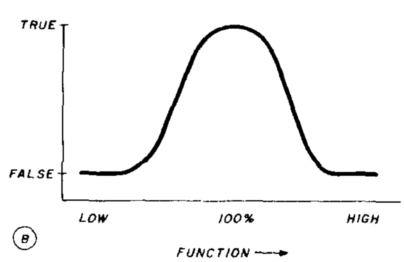

fig. 1. (A) Determinate logic, in which "OK" has a narrow range and (B) indeterminate logic, in which "OK" is not so clear.

The bottom line for all of this is actually a reliability issue. If devices can be designed to operate with some form of judgment that allows them to weigh external influences, or assess their own degradation, then perhaps these devices will function longer, or with less error, than devices that will only "run" or "break." In the indeterminate case we have the option of continuing the function if things are "true enough" to be "mostly OK." Deciding that you have "enough" air in a "flat" tire to make it to the next gas station is an example. This "new" class of logic will be interesting to observe as it is implemented in artificially intelligent devices.

FM broadcasters set spectrum standards

In April, 1984, the FCC deregulated the way in which commerical FM broadcasters (88-108 MHz) can use their assigned 200 kHz spectrum slot. A stereo audio broadcast uses 106 kHz ($\pm$53 kHz) of the assigned slot, and the FCC has said that the broadcasters are free to have as many subsidiary communications authorization (SCA) channels in their slots as they like. The broadcasters have been quick to recognize that the unused 94 kHz ($\pm$47 kHz) is valuable spectrum that reaches into every home and business in their service area. Among the applications that *they have implemented in the past year* are 9600 baud videotext for stock and commodity businesses. This data rate allows a full screen update every 6 *seconds. In addition, the data stream* can be coded to provide different data to different subscribers.

Additional uses now include traffic *alerts sent to properly equipped car* radios, full color graphics transmission (at about 10 seconds per screen), radio teleshopping, and perhaps the most *financially rewarding application*, personal paging. This last use is significant because of the excellent coverage most FM stations get by virtue of their high power and advantageous antenna siting. The applications are limited only by how many subcarriers and modulation techniques the broadcasters can stuff into the allocated space, yet still maintain the requisite quality for each transmission mode.

For Amateurs who complain that we don't have enough space to do our thing, the FM broadcasters are setting an example of efficient spectrum utilization that bears watching.

high speed health hazards

The fabrication of very high speed digital and microwave semiconductor devices requires the use of many exotic materials. Gallium and indium arsenides, phosphorus, and cyanide recovery agents are among the many materials in regular use. Unfortunately, these materials that are so beneficial to technology are deadly to most living things. The cities surrounding California's Silicon Valley are now observing disturbing levels of many of these undesirable materials in local water supplies. The omens are not good. The entire electronic industry must view this matter with urgent alarm, lest the plants — which have caused our industry to flower — die from their own droppings.

ham radio

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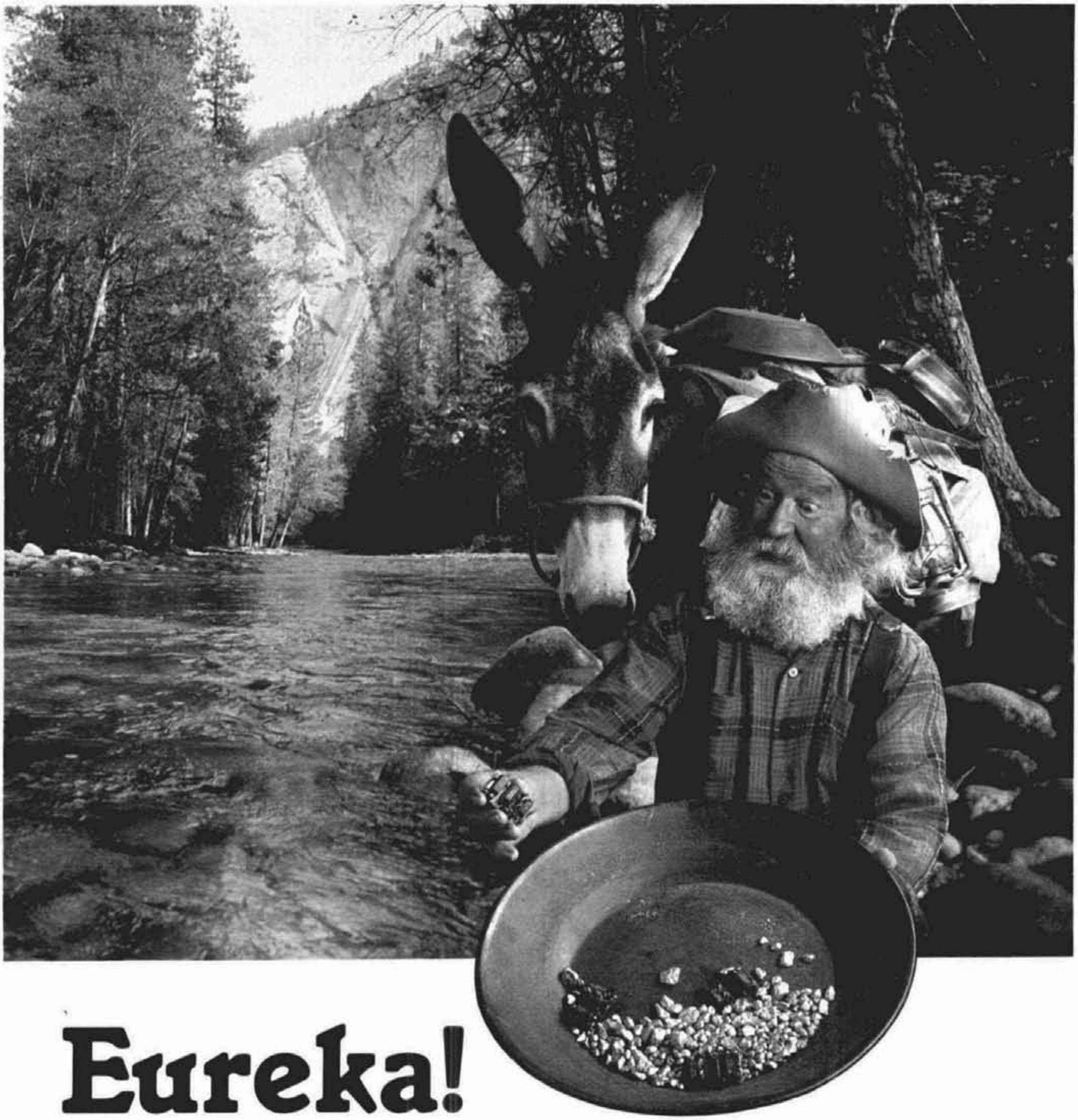

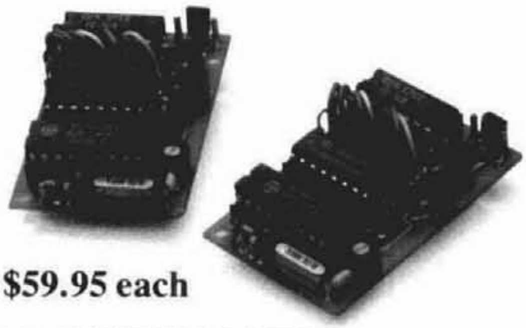


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